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Cover photo: *Hottonia inflata* (American featherfoil) by Amy K. Buthod

Foreword

This issue of the *Oklahoma Native Plant Record* contains reports of efforts to document the biological diversity of Oklahoma, including vascular plant surveys of two Nature Conservancy preserves, an account of the discovery of a population of a critically imperiled plant species that had been thought to be extirpated from Oklahoma, and an article that will facilitate identification of Oklahoma's common *Amanita* species. Also included is a summary of an investigation that might lead us to question the wisdom of planting non-native milkweeds as part of the conservation effort to protect monarch butterflies.

Amy Buthod and Bruce Hoagland from the University of Oklahoma conducted vascular plant surveys of two biologically diverse Nature Conservancy preserves in south-central Oklahoma: the Hottonia Bottoms Preserve and the Oka' Yanahli Preserve. The Hottonia Bottoms Preserve contains several forest and herbaceous vegetation types with a high number of obligate and facultative wetland taxa. The preserve is named for one of the wetland plants, *Hottonia inflata* (American featherfoil), pictured on the cover of this issue. The Oka' Yanahli Preserve, located along the Blue River, contains a variety of grassland, forest, shrubland, and wetland vegetation types. The cobble bars and riparian areas of this preserve provide habitat for the imperiled shrub *Alnus maritima* (seaside alder).

Audrey Whaley, Monika Kelley, and Allison Holdorf of the National Ecological Observatory Network (NEON) Project report their discovery of a population of *Palafoxia callosa* (small palafox) in Washita County, Oklahoma. Previously reported only from Caddo and Pontotoc counties several decades ago, this species had been listed as possibly extirpated from Oklahoma. In a time when we hear more often about the disappearance of species, it is heartening to hear of a discovery of a new population of a critically imperiled species in our state.

Clark Ovrebo from the University of Central Oklahoma and Jay Justice from the Arkansas Mycological Society describe and illustrate twenty of the most frequently encountered species of *Amanita* in forests of Oklahoma. They explain the morphological characters that are most important in the identification and classification of the species of this charismatic genus of gilled mushrooms.

Kayleigh Clement and Priscilla Crawford from the University of Oklahoma investigate the utilization of the non-native tropical milkweed versus native milkweeds by migrating monarch butterflies in the fall. They suggest the availability of non-native tropical milkweed until late fall could be detrimental to monarch conservation by stimulating the monarchs to break reproductive diapause, compromising their ability to continue their journey to Mexico.

Please consider publishing your work in the *Oklahoma Native Plant Record*. It is listed in the Directory of Open Access Journals, is abstracted by the Centre for Agricultural Bioscience International, and can be accessed by researchers around the world.

Gloria Caddell
Managing Editor

A FLORISTIC INVENTORY OF THE NATURE CONSERVANCY'S HOTTONIA BOTTOMS PRESERVE, ATOKA, BRYAN, AND CHOCTAW COUNTIES, OKLAHOMA

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ABSTRACT

This paper reports the results of a vascular plant inventory at The Nature Conservancy's Hottonia Bottoms Preserve in Atoka, Bryan, and Choctaw Counties, Oklahoma. A total of 386 taxa in 96 families were collected. Two-hundred and fifty-six genera, 369 species, and 17 infraspecific taxa were identified. The largest families found were the Poaceae with 53 taxa and the Asteraceae with 44 taxa. Twenty-four non-native or naturalized taxa, or 6.22% of the preserve's flora, were collected. Twenty taxa tracked by the Oklahoma Natural Heritage Inventory were found.

Keywords: vascular, exotic, tracked

INTRODUCTION AND STUDY AREA

Purchased in 2016, The Nature Conservancy's (TNC) Hottonia Bottoms Preserve was acquired with the goal of conserving a high-quality example of Oklahoma bottomland forest. Bottomland forests provide many ecosystem services, including the protection of water quality, flood control, and erosion control, but less than 15% of these habitats remain intact (Anderson and Masters 1992). TNC intends to manage the preserve for biodiversity and habitat through surveys, monitoring, invasive species management, and prescribed fire. Rare animals, including the western chicken turtle, the goldstripe darter, and the Federally-listed American burying beetle are found at the preserve. The preserve also provides habitat for migratory birds in the central flyway. Hottonia Bottoms is named for the unique aquatic plant American featherfoil (*Hottonia inflata*).

The Hottonia Bottoms preserve occupies 397 ha in Atoka, Bryan, and Choctaw Counties in south-central Oklahoma approximately 16 km south of the town of Lane (Figure 1). The southern boundary of some parts of the preserve is the Clear Boggy Creek, a 212 km tributary of Muddy Boggy Creek. Crooked Creek runs through the western part of the preserve. Latitudinal extent ranges from 34.1222912 to 34.160174 and longitudinal extent from -95.929407 to -96.038570. The

site is located within the Dissected Coastal Plain geomorphic province, consisting of unlithified sands, gravels, and clays from the early Cretaceous period (Curtis et al. 2008; Johnson 2008). Soils are primarily of the Guyton-Kaufman type and clayey, silty, and very deep (Carter and Gregory 2008). Chigley-Durant-Clarita-Helden-Ferris-Burleson type soils are also present; these are humus-rich, clayey and deep (Carter and Gregory 2008). Climate is classified as humid subtropical (Cfa) – temperate with no discernible dry season, and with hot summers (Köppen 1884). Choctaw County, the county with the majority of the preserve's land, has a mean annual temperature of 16.9°C (Oklahoma Climatological Survey 2020). The lowest average temperature is in January (5.2°C) and the highest average temperature is in August (27.8°C) (Oklahoma Climatological Survey 2020). May is the wettest month, with average precipitation of 15.1 cm, and August is the driest, with 6.4 cm; mean annual precipitation is 123.1 cm (Oklahoma Climatological Survey 2020). The growing season averages 225 days (Oklahoma Climatological Survey 2020). The potential vegetation types are bottomland and crosstimbers forests (Duck and Fletcher 1943). The Antlers Sandstone aquifer underlies the preserve.

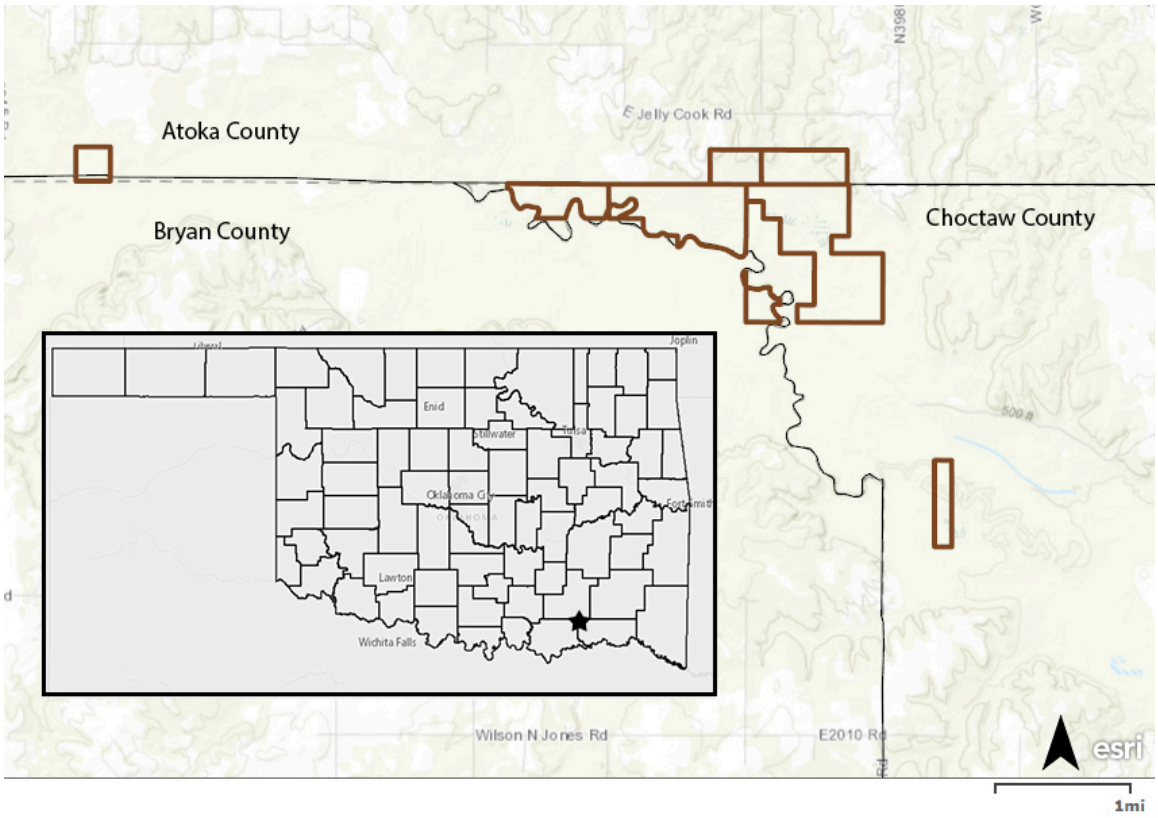

Figure 1 The Nature Conservancy's Hottonia Bottoms Preserve

METHODS

Vouchers of vascular plant taxa encountered at the Hottonia Bottoms Preserve were made throughout the growing seasons (March through October) of 2016 and 2017. Specimens with flowers or fruit were preferred, but when they could not be found, sterile specimens were taken. Vouchers of planted taxa and taxa not native to the United States were collected only from naturalized populations. All specimens were pressed in a plant press, dried in a drying cabinet, and frozen at -20° before taken into the herbarium for identification and label generation. Manuals used for identification included Smith (1994) and Tyrl et al. (2015). Identifications were verified by comparison with specimens from the Robert Bebb Herbarium (OKL) at the University of Oklahoma. Duration, growth habit, wetland status, and nativity were determined using the PLANTS database (USDA-NRSC 2020) and Taylor and Taylor (1991). Vegetation classifications were based on Hoagland (2000). Classification and nomenclature follow the Angiosperm Phylogeny Group IV (Stevens 2001 onwards) and the Integrated Taxonomic Information System (2020). All specimens were deposited at OKL.

RESULTS AND DISCUSSION

A total of 386 taxa in 96 families were collected (Appendix). Eight of these families were ferns and allies, two were conifers, two were magnoliids/primitive angiosperms, 10 were monocots, and 74 were eudicots (Table 1). Two hundred and fifty-six genera, 369 species, and 17 infraspecific taxa were identified. Two hundred and eighty taxa were perennials; there were 102 annuals and four biennials. Two hundred and twenty-seven of these taxa were forbs, 92 were graminoids, 39 were trees, 15 were shrubs, and 13 were woody vines. The largest families were the Poaceae and the Asteraceae, with 53 and 44 taxa respectively, and the genus with the most taxa was *Carex* in the Cyperaceae family (20 taxa). Only 24 taxa, or 6.22% of the flora, were planted and naturalized or non-native to the United States. This is a relatively small percentage; a survey of the less extensive (235 ha) Boehler Seeps and Sandhills Preserve found 37 exotic taxa, or 8.17% of its flora (Hoagland and Buthod, in preparation). Grassland sites in Oklahoma have been found to have 8.80-15.00% (Buthod and Hoagland, 2020) of their floras composed of exotic species. The families with the most exotic taxa were the Fabaceae with five and the Poaceae with four. Twenty species tracked by the Oklahoma Natural Heritage Inventory (2020) occurred at the preserve (Table 2). Obligate and facultative wetland taxa comprised 28.76% of the flora, with 40 obligate wetland and 71 facultative wetland taxa present. Ninety-two taxa were classified as facultative, 87 were facultative upland taxa, and nine were upland taxa. Eighty-seven taxa had no wetland status.

Table 1 Summary of the floristic survey performed at the Hottonia Bottoms Nature Preserve by divisions/groups and resulting number of taxa

Groups	Families	Genera	Total Taxa	Total Taxa Composition %	Native Taxa	Nonnative Taxa	Nonnative Taxa Composition %
Ferns and Allies	8	8	8	2.07	8	0	0.0
Gymnosperms	2	2	2	0.52	2	0	0.0
Magnoliids/Primitive Angiosperms	2	2	2	0.52	2	0	0.0
Monocots	10	45	104	26.94	99	5	1.30
Eudicots	74	199	260	67.36	253	19	4.92
TOTAL	96	256	386	100	352	24	6.22

Table 2 Taxa located during this study that are tracked by the Oklahoma Natural Heritage Inventory (NatureServe Explorer 2020; Oklahoma Natural Heritage Inventory 2020). Status ranks are on a 1-5 scale, with a 1 indicating the taxon is critically imperiled. G ranks are at the global level, and S ranks are at the subnational or state level. A question mark (?) denotes an inexact numeric rank.

Family	Taxon	Rank
Apiaceae	*Ptilimnium costatum* Raf.	S1G4
Aristolochiaceae	*Aristolochia reticulata* Nutt.	S2G4
Cyperaceae	*Carex gigantea* Rudge	S1G4
Cyperaceae	*Carex hyalina* Boott	S2G4
Cyperaceae	*Carex oxylepis* Torr. & Hook.	S2G5?
Cyperaceae	*Carex typhina* Michx.	S1G5
Cyperaceae	*Cyperus plukenetii* Fernald	S2G5
Fabaceae	*Phaseolus polystachios* (L.) Britton, Sterns & Poggenb.	S1G5
Fagaceae	*Quercus incana* W. Bartram	S2G5
Lamiaceae	*Physostegia intermedia* (Nutt.) Engelm. & A. Gray	S1G5
Oleaceae	*Forestiera acuminata* (Michx.) Poir.	S2G5
Orchidaceae	*Hexalectris spicata* (Walter) Barnhart	S1G5
Plantaginaceae	*Penstemon murrayanus* Hook	S1G4
Poaceae	*Aristida lanosa* Muhl. ex Elliott	S1G5
Poaceae	*Paspalum bifidum* (Bertol.) Nash	S1G5
Poaceae	*Sacciolepis striata* (L.) Nash	S2G5
Poaceae	*Sorghastrum elliottii (C. Mohr) Nash*	S1G5
Primulaceae	*Hottonia inflata* Elliott	S2G4
Ulmaceae	*Planera aquatica* J.F. Gmel.	S2G5
Urticaceae	*Urtica chamaedryoides* Pursh	S3G4G5

Six vegetation types were found at Hottonia Bottoms. Three forest associations, two herbaceous vegetation types, and a "disturbed area" type occur at the preserve. The types are not discrete, however; they intergrade, with many taxa found in multiple types.

Forest vegetation includes a dry hardwood **upland forest (UF)** type that is dominated by *Quercus stellata*, *Q. velutina*, *Q. falcata*, and *Carya texana*. This type is found in the northernmost parts of the preserve. Trees such as *Pinus echinata*, *Ulmus alata,* and *Juniperus virginiana* are associated with this type, as are understory shrubs such as *Viburnum rufidulum*, *Vaccinium arboreum,* and *Symphoricarpos orbiculatus*. Extensive stands of *Callicarpa americana* are also found in the upland forests of Hottonia Bottoms. Forbs and graminoids in this type include many taxa tracked by the Oklahoma Natural Heritage Inventory, including *Aristolochia reticulata*, *Hexalectris spicata*, and *Sorghastrum elliottii*, as well as more common taxa such as *Tridens flavus*, *Elymus virginicus*, and *Coleataenia anceps*. Within the upland forest are small areas with little canopy cover where taxa such as *Penstemon murrayanus*, *Asclepias amplexicaulis*, *Lithospermum caroliniense*, and *Aristida lanosa* are found.

A ***Quercus phellos-Q. nigra*** **forest (QPQNF)** is found in a transitional zone between the drier upland forest and bottomland vegetation. In this forest type soils are moist to wet, the canopy is dense, and the diversity of the understory is low. Other tree species in this type include *Quercus lyrata*, *Nyssa sylvatica*, and *Acer negundo*. Shrubs such as *Sambucus nigra* ssp. *canadensis* and *Ilex decidua* are found in the understory. The forest floor is dominated by *Chasmanthium latifolium*, *C. laxum* ssp. *laxum*, *C. laxum* ssp. *sessiliflorum,* and many species of *Carex*.

The ***Fraxinus pennsylvanica*** **forest association (FPFA)** is found in the bottomlands of the preserve that are temporarily or seasonally flooded. Associated woody species include *Celtis laevigata*, *Platanus occidentalis*, *Salix nigra*, and *Cephalanthus occidentalis*. Large stands of *Forestiera acuminata* are found throughout this forest type, as are three tracked *Carex* species (*C. gigantea*, *C. hyalina*, and *C. typhina*), and the preserve's namesake *Hottonia inflata*.

Herbaceous vegetation types at Hottonia Bottoms are limited in extent because of the dense forest canopy. One of these--the ***Dichanthelium scoparium*** **herbaceous association (DSHA)**--is a type associated with the sandy acidic seeps found at the preserve. Taxa associated with this vegetation type include *Andropogon glomeratus*, *Boehmeria cylindrica*, *Cirsium horridulum*, *Eupatorium perfoliatum*, and *Juncus effusus*. These small areas are often densely vegetated and overgrown with *Smilax* and *Rubus*. With the reintroduction of fire they could harbor populations of the globally and state rare *Eriocaulon kornickianum*, a species once found less than five kilometers away at The Nature Conservancy's Boehler Seeps and Sandhills Preserve (Watson et al. 1994; MacRoberts and MacRoberts 2002; Clark 2011).

The type given the general classification **"herbaceous wetland vegetation" (HWV)** is highly restricted in extent as well; it is found in a small, low, open spot on an old dirt road and areas in and around Crooked Creek. Taxa associated with this type include *Echinochloa muricata, Iva annua*, *Lobelia cardinalis*, *Mimulus alatus,* and *Paspalum repens*.

Only small areas of Hottonia Bottoms are **disturbed areas (DA)**; they are limited to a small parking area in the upland forest and an old road which runs from it to the south. Taxa associated with disturbed areas include *Bradburia pilosa*, *Digitaria ciliaris*, *Sida spinosa*, and *Galium aparine*. The majority (13 of 24) of the non-native taxa found at Hottonia Bottoms are found in these areas, including *Cerastium* spp., *Trifolium* spp., *Capsella bursa-pastoris*, and *Verbascum thapsus*.

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APPENDIX

List of vascular plant taxa from the Hottonia Bottoms Nature Preserve, Atoka, Bryan and Choctaw Counties, Oklahoma.

Taxa list with duration, growth habit, wetland status, vegetation type, collection number, nativity, and heritage status. A=annual, B=biennial, P=perennial; T=tree, S=shrub, V=woody vine, F=forb, G=graminoid; OBL=obligate wetland, FACW= facultative wetland, FAC=facultative, FACU=facultative upland, UPL=upland, none=no wetland status; DA=disturbed area, DSHA=*Dichanthelium scoparium* herbaceous association, FPFA=*Fraxinus pennsylvanica* forest association, HWV=herbaceous wetland vegetation, QPQNF=*Quercus phellos/Quercus nigra* forest, UF=upland forest.

Exotic taxa are denoted with an asterisk (*). Taxa tracked by the Oklahoma Natural Heritage Inventory are denoted with a dagger (†). Duration, growth habit, and nativity were determined using the PLANTS Database (USDA-NRCS 2020); if the information from PLANTS was ambiguous, Taylor and Taylor (1991) was consulted. Wetland status and common names were taken from PLANTS (USDA-NRCS 2020), and vegetation classifications were based on Hoagland (2000). Specimens were assigned collection numbers with the prefix HB. Voucher specimens were deposited at the Robert Bebb Herbarium of the University of Oklahoma (OKL).

Acanthaceae
Dicliptera brachiata (Pursh) Spreng. (branched foldwing); A; F; FACW; HWV; HB-164
Ruellia humilis Nutt. (fringeleaf wild petunia); P; F; FACU; UF; HB-172
Ruellia strepens L. (limestone wild petunia); P; F; FAC; UF; HB-324

Adoxaceae
Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli (American elder); P; S; NONE; QPQNF; HB-014
Viburnum rufidulum Raf. (rusty blackhaw); P; S; UPL; UF; HB-304

Alismataceae
Echinodorus cordifolius (L.) Griseb. (burhead); P; F; OBL; FPFA; HB-422

Amaryllidaceae
**Allium vineale* L. (wild garlic); P; F; FACU; DA; HB-096
Nothoscordum bivalve (L.) Britton (crowpoison); P; F; FACU; DA; HB-103

Anacardiaceae
Rhus aromatica Aiton (fragrant sumac); P; S; UPL; UF; HB-275
Toxicodendron radicans (L.) Kuntze (poison ivy); P; V; FAC; UF, QPQNF; HB-382

Apiaceae
Chaerophyllum tainturieri Hook. (chervil); A; F; FAC; UF; QPQNF; HB-007
Cryptotaenia canadensis (L.) DC. (honewort); P; F; FAC; UF; QPQNF; HB-075
Cynosciadium digitatum DC. (fringed dogshade); A; F; FACW; FPFA; HB-036
Eryngium prostratum Nutt. ex DC. (creeping eryngo); P; F; FACW; DSHA; HB-193
†*Ptilimnium costatum* Raf. (threadleaf mockbishopweed); A; F; FACW; DSHA; HB-043; S1G4
Sanicula canadensis L. (Canadian blacksnakeroot); B; F; FACU; UF; HB-118

Spermolepis divaricata (Benth. & Hook. f. ex S. Watson) Raf. ex Ser. (forked scaleseed); A; F; FAC; FPFA; HB-114
Trepocarpus aethusae Nutt. ex DC. (whitenymph); A; F; FACW; QPQNF; HB-029

Apocynaceae
Asclepias amplexicaulis Sm. (clasping milkweed); P; F; NONE; UF; HB-298
Gonolobus suberosus (L.) Br. var. *suberosus* (angularfruit milkvine); P; F; FACW; UF; HB-083

Aquifoliaceae
Ilex decidua Walter (possomhaw); P; S; FACW; QPQNF; HB-171

Araceae
Arisaema dracontium (L.) Schott (green dragon); P; F; FACW; QPQNF; HB-341

Araliaceae
Hydrocotyle ranunculoides L.f. (floating pennyroyal); P; F; OBL; DSHA, HWV; HB-373

Aristolochiaceae
†*Aristolochia reticulata* Nutt. (Texas dutchman's pipe); P; F; NONE; UF; HB-016; S2G4

Aspleniaceae
Asplenium platyneuron (L.) Britton, Sterns & Poggenb. (ebony spleenwort); P; F; FACU; UF; HB-065

Asteraceae
Achillea millefolium L. (common yarrow); P; F; FACU; DA; HB-269
Ageratina altissima (L.) King & H. Rob. var. *altissima* (white snakeroot); P; F; FACU; QPQNF; HB-236
Ambrosia artemisiifolia L. (annual ragweed); A; F; FACU; DA; HB-144
Ambrosia bidentata Michx. (lanceleaf ragweed); A; F; NONE; DA, UF; HB-245
Antennaria parlinii Fernald (Parlin's pussytoes); P; F; NONE; UF; HB-368
Bidens bipinnata L. (Spanish needles); A; F; FAC; HWV; HB-025
Bidens frondosa L. (devil's beggartick); A; F; FACW; HWV; HB-244
Bradburia pilosa (Nutt.) Semple (soft goldenaster); A; F; NONE; DA; HB-142
Brickellia eupatorioides (L.) Shinners (false boneset); P; F; NONE; UF; HB-163
Cirsium altissimum (L.) Hill (tall thistle); B; F; NONE; DA; HB-202
Cirsium horridulum Michx. (yellow thistle); B; F; FAC; DSHA; HB-291
Conoclinium coelestinum (L.) DC (blue mistflower); P; F; FAC; HWV, QPQNF; HB-188
Conyza canadensis (L.) Cronquist (Canadian horseweed); A; F; NONE; DA; HB-139
Coreopsis tinctoria Nutt. (golden tickseed); A; F; FAC; DA, HWV; HB-388
Croptilon divaricatum (Nutt.) Raf. (slender scratchdaisy); A; F; UPL; UF; HB-243
Eclipta prostrata (L.) L. (false daisy); A; F; FACW; HWV; HB-206
Elephantopus carolinianus Raeusch. (Carolina elephantsfoot); P; F; FACU; QPQNF, UF; HB-184
Erechtites hieraciifolius (L.) Raf. ex DC. (American burnweed); A; F; NONE; DA, UF; HB-133
Erigeron strigosus Muhl. ex Willd. (prairie fleabane); A; F ; FAC; DA; HB-319
Eupatorium perfoliatum L. (common boneset); P; F ; FACW; DSHA ; HB-186
Eupatorium serotinum Michx. (lateflowering thoroughwort); P; F; FAC; HB-404
Fleischmannia incarnata (Walter) King & H. Rob. (pink thoroughroot); P; F; FACU; DA; HB-237
Gamochaeta pensylvanica (Willd.) Cabrera (Pennsylvania everlasting); P; F; FACU; UF; HB-364

Helenium amarum (Raf.) H. Rock (yellowdicks); A; F; FACU; DA; HB-192
Heterotheca subaxillaris (Lam.) Britton & Rusby (camphorweed); A; F; NONE; DA; HB-173
Hieracium gronovii L. (queendevil); P; F; UPL; UF; HB-423
Iva annua L. (annual marsh elder); A; F; FAC; HWV; HB-138
Lactuca ludoviciana (Nutt.) Riddell (wild lettuce); A; F; FAC; QPQNF; HB-037
Mikania scandens (L.) Willd. (climbing hempvine); P; F; FACW; DSHA; HB-203
Packera glabella (Poir.) C. Jeffrey (butterweed); A; F; FACW; FPFA, QPQNF; HB-286
Packera obovata (Muhl. ex Willd.) W.A. Weber & A. Löve (roundleaf ragwort); P; F; FACU; QPQNF; HB-088
Pluchea odorata (L.) Cass. (sweetscent); A; F; FACW; DSHA, HWV; HB-242
Pseudognaphalium obtusifolium (L.) Hilliard & B.L. Burtt (rabbit-tobacco); A; F; NONE; UF; HB-125
Pyrrhopappus carolinianus (Walter) DC. (Carolina desert-chicory); A; F; NONE; DA; HB-378
Rudbeckia hirta L. (blackeyed Susan); P; F; FACU; DA, UF; HB-066
Smallanthus uvedalia (L.) Mack. ex Small (hairy leafcup); P; F; NONE; UF; HB-227
Solidago nemoralis Aiton (gray goldenrod); P; F; NONE; UF; HB-432
Solidago ulmifolia Muhl. ex Willd. var. *palmeri* Cronquist (Palmer's goldenrod); P; F; NONE; UF; HB-195
Symphyotrichum lanceolatum (Willd.) G.L. Nesom (white panicle aster); P; F; NONE; UF; HB-436
Symphyotrichum lateriflorum (L.) Á. Löve & D. Löve (calico aster); P; F; FAC; QPQNF; HB-215
Symphyotrichum oolentangiense (Riddell) G.L. Nesom (skyblue aster); P; F; NONE; UF; HB-434
Symphyotrichum patens (Aiton) G.L. Nesom var. *patens* (late purple aster); P; F; NONE; UF; HB-143
Verbesina virginica L. (white crownbeard); P; F; FACU; QPQNF; HB-140
Xanthium strumarium L. (spiny cocklebur); A; F; FAC; HWV; HB-134

Balsaminaceae
Impatiens capensis Meerb. (jewelweed); A; F; FACW; FPFA; HB-025

Berberidaceae
Podophyllum peltatum L. (May apple); P; F; FACU; UF, QPQNF; HB-284

Betulaceae
Betula nigra L. (river birch); P; T; FACW; HWV; HB-395

Bignoniaceae
Campsis radicans (L.) Seem. ex Bureau (trumpet creeper); P; V; FAC; FPFA; HB-391

Blechnaceae
Woodwardia areolata (L.) T. Moore (netted chainfern); P; F; OBL; DSHA; HB-210

Boraginaceae
Hackelia virginiana (L.) I.M. Johnst. (Virginia stickseed); P; F; FAC; QPQNF; HB-336
Myosotis macrosperma Engelm. (southern forget-me-knot); A; F; FAC; QPQNF; HB-089
Lithospermum caroliniense (Walter ex J.F. Gmel.) MacMill. (Carolina puccoon); P; F; NONE; UF; HB-316

Brassicaceae
**Capsella bursa-pastoris* (L.) Medik. (shepherdspurse); A; F; FACU; DA; HB-278

**Cardamine hirsuta* L. (hairy bittercress); A; F; FACU; DA; HB-099
Cardamine pensylvanica Muhl. ex Willd. (Pennsylvania bittercress); P; F; FACW; FPFA; HB-305
Rorippa palustris (L.) Besser (bog marshcress); A; F; OBL; FPFA; HB-296

Cactaceae
Opuntia humifusa (Raf.) Raf. (devil's tongue); P; S; NONE; UF; HB-107

Campanulaceae
Lobelia cardinalis L. (cardinalflower); P; F; FACW; HWV; HB-161
Triodanis perfoliata (L.) Nieuwl. ssp. *perfoliata* (clasping Venus' looking-glass); A; F; FACU; QPQNF, UF; HB-322

Cannabaceae
Celtis laevigata Willd. (sugarberry); P; T; FACW; FPFA; HB-343

Caprifoliaceae
**Lonicera japonica* Thunb. (Japanese honeysuckle); P; V; FACU; QPQNF, UF; HB-266
Symphoricarpos orbiculatus Moench (coralberry); P; S; FACU; QPQNF, UF; HB-148

Caryophyllaceae
**Cerastium glomeratum* Thuill. (sticky chickweed); A; F; FACU; DA; HB-090
**Cerastium pumilum* W. Curtis (European chickweed); A; F; NONE; DA; HB-254
**Stellaria media* (L.) Vill. (chickweed); A; F; FACU; DA; HB-098

Cistaceae
Lechea mucronata Raf. (hairy pinweed); P; F; NONE; UF; HB-371

Commelinaceae
Commelina erecta L. (erect dayflower); P; F; FACU; UF; HB-117
Commelina virginica L. (Virginia dayflower); P; F; FACW; QPQNF; HB-077
Tradescantia ohiensis Raf. (Ohio spiderwort); P; F; FAC; UF; HB-325

Convolvulaceae
Cuscuta obtusiflora Kunth (Peruvian dodder); P; F; NONE; UF; HB-235
Dichondra carolinensis Michx. (Carolina ponysfoot); P; F; FAC; QPQNF; HB-257
Ipomoea lacunosa L. (white morningglory); A; F; FAC; HWV; HB-127

Cornaceae
Cornus drummondii C.A. Mey. (roughleaf dogwood); P; T; FAC; QPQNF; HB-272
Cornus florida L. (flowering dogwood); P; T; FACU; UF; HB-282

Cucurbitaceae
Melothria pendula L. (Guadeloupe cucumber); P; F; FAC; DA; HB-031

Cupressaceae
Juniperus virginiana L. (eastern red cedar); P; T; FACU; QPQNF, UF; HB-225

Cyperaceae
Carex albicans Willd. ex Spreng. (whitetinge sedge); P; G; FAC; QPQNF, UF; HB-095
Carex aureolensis Steud. (goldenfruit sedge); P; G; NONE; FPFA; HB-063
Carex blanda Dewey (bland sedge); P; G; FAC; QPQNF; HB-357
Carex cephalophora Muhl. ex Willd. (ovalleaf sedge); P; G; FAC; QPQNF; HB-365
Carex cherokeensis Schwein. (Cherokee sedge); P; G; FACW; FPFA, QPQNF; HB-091
Carex crus-corvi Shuttlew. ex Kunze (ravenfoot sedge); P; G; OBL; FPFA; HB-051
Carex flaccosperma Dewey (thinfruit sedge); P; G; FACW; FPFA, QPQNF; HB-329
†*Carex gigantea* Rudge (giant sedge); P; G; OBL; FPFA; HB-385; S1G4
†*Carex hyalina* Boott (tissue sedge); P; G; FACW; FPFA; HB-334; S2G4
Carex leavenworthii Dewey (Leavenworth's sedge); P; G; NONE; QPQNF; HB-332
Carex louisianica L.H. Bailey (Louisiana sedge); P; G; OBL; FPFA; HB-338
Carex lupuliformis Sartwell ex Dewey (false hop sedge); P; G; OBL; FPFA; HB-123
Carex lurida Wahlenb. (shallow sedge); P; G; OBL; FPFA; HB-340
Carex muehlenbergii Schkuhr ex Willd. (Muhlenberg's sedge); P; G; NONE; QPQNF; HB-121
†*Carex oxylepis* Torr. & Hook. (sharpscale sedge); P; G; FACW; QPQNF; HB-328; S2G5?
Carex planispicata Naczi (flat-spiked sedge); P; G; NONE; QPQNF; HB-366
Carex retroflexa Muhl. ex Willd. (reflexed sedge); P; G; FACU; UF; HB-360
Carex texensis (Torr.) L.H. Bailey (Texas sedge); P; G; NONE; UF; HB-333
Carex tribuloides Wahlenb. (blunt broom sedge); P; G; FACW; FPFA; HB-331
†*Carex typhina* Michx. (cattail sedge); P; G; OBL; FPFA, QPQNF; HB-280; S1G5
Cyperus croceus Vahl (Baldwin's flatsedge); P; G; FAC; QPQNF; HB-004
Cyperus echinatus (L.) Alph. Wood (globe flatsedge); P; G; FAC; QPQNF, UF; HB-026
Cyperus erythrorhizos Muhl. (red-root flatsedge); A; G; OBL; FPFA, HWV; HB-219
†*Cyperus plukenetii* Fernald (Plukenet's flatsedge); P; G; NONE; UF; HB-240; S2G5
Cyperus pseudovegetus Steud. (marsh flatsedge); P; G; FACW; FPFA, HWV; HB-064
Cyperus retroflexus Buckley (oneflower flatsedge); P; G; NONE; UF; HB-369
Eleocharis lanceolata Fernald (daggerleaf spikerush); A; G; FACW; HWV; B-040
Eleocharis obtusa (Willd.) Schult. (blunt spikesedge); A; G; OBL; DSHA, HWV; HB-372
Isolepis carinata Hook. & Arn. ex Torr. (keeled bulrush); A; G; FACW; DA; HB-264
Rhynchospora corniculata (Lam.) A. Gray (shortbristle horned beaksedge); P; G; OBL; HWV; HB-011
Rhynchospora glomerata (L.) Vahl (clustered beaksedge); P; G; OBL; HWV; HB-379

Dryopteridaceae
Polystichum acrostichoides (Michx.) Schott (Christmas fern); P; F; FACU; UF; HB-093

Ebenaceae
Diospyros virginiana L. (eastern persimmon); P; T; FAC; FPFA, QPQNF; HB-182

Ericaceae
Vaccinium arboreum Marsh (farkleberry); P; S; FACU; UF; HB-018

Euphorbiaceae
Acalypha gracilens A. Gray (slender copperleaf); A; F; FAC; QPQNF; HB-416
Acalypha virginica L. (Virginia copperleaf); A; F; FACU; QPQNF, UF; HB-007
Cnidoscolus texanus (Müll. Arg.) Small (bullnettle); P; F; NONE; UF; HB-273
Croton capitatus Michx. (wooly croton); A; F; NONE; DA; HB-212

Croton glandulosus L. (vente conmigo); A; F; NONE; DA; HB-211
Croton monanthogynus Michx. (prairie-tea); A; F; NONE; DA, UF; HB-181
Euphorbia cyathophora Murray (fire on the mountain); A; F; FACU; UF; HB-136
Euphorbia dentata Michx. (toothed spurge); A; F; NONE; DA, UF; HB-246

Fabaceae
**Albizia julibrissin* Durazz. (silktree); P; T; NONE; QPQNF; HB-158
Amphicarpaea bracteata (L.) Fernald (American hogpeanut); A; F; FAC; QPQNF; HB-150
Apios americana Medik. (groundnut); P; F; FACW; HWV; HB-409
Baptisia bracteata Muhl. ex Elliott (longbract wild indigo); P; F; NONE; UF; HB-285
Centrosema virginianum (L.) Benth. (spurred butterfly pea); P; F; NONE; UF; HB-410
Cercis canadensis L. (eastern redbud); P; T; UPL; UF; HB-200
Chamaecrista nictitans (L.) Moench (sensitive partridge pea); A; F; FACU; DA; HB-189
Clitoria mariana L. (Atlantic pigeonwings); P; F; FACU; UF; HB-019
Crotalaria sagittalis L. (arrowhead rattlebox); P; F; NONE; UF; HB-177
Desmodium ciliare (Muhl. ex Willd.) DC. (littleleaf tickclover); P; F; NONE; UF; HB-124
Desmodium glabellum (Michx.) DC. (Dillenius' ticktrefoil); P; F; NONE; UF; HB-429
Desmodium paniculatum (L.) DC. var. *paniculatum* (narrowleaf ticktrefoil); P; F; FACU; UF; HB-166
Desmodium perplexum B.G. Schub. (perplexed ticktrefoil); P; F; NONE; UF; HB-167
Desmodium viridiflorum (L.) (velvetleaf ticktrefoil); P; F; NONE; UF; HB-424
Galactia regularis (L.) Britton, Sterns & Poggenb. (eastern milkpea); P; F; NONE; UF; HB-337
Gleditsia triacanthos L. (honeylocust); P; T; FAC; QPQNF; HB-288
**Kummerowia striata* (Thunb.) Schindl (Japanese clover); A; F; FACU; DA, UF; HB-249
**Lespedeza cuneata* (Dum. Cours.) G. Don (sericea lespedeza); P; F; FACU; DA, UF; HB-414
Lespedeza hirta (L.) Hornem. ssp. *hirta* (hairy lespedeza); P; F; NONE; UF; HB-439
Lespedeza repens (L.) W.P.C. Barton (creeping lespedeza); P; F; NONE; UF; HB-313
Lespedeza stuevei Nutt. (tall lespedeza); P; F; NONE; UF; HB-162
Lespedeza virginica (L.) Britton (slender lespedeza); P; F; NONE; UF; HB-223
†*Phaseolus polystachios* (L.) Britton, Sterns & Poggenb. (thicket bean); P; F; NONE; QPQNF; HB-437; S1G5
Rhynchosia latifolia Nutt. ex Torr. & A. Gray (prairie snoutbean); P; F; NONE; UF; HB-013
Strophostyles helvola (L.) Elliott (amberique-bean); A; F; FAC; QPQNF; HB-152
Strophostyles umbellata (Muhl. ex Willd.) Britton (pink fuzzybean); P; F; FAC; QPQNF; HB-169
Stylosanthes biflora (L.) Britton, Sterns & Poggenb. (sidebeak pencilflower); P; F; NONE; UF; HB-082
Tephrosia virginiana (L.) Pers. (Virginia tephrosia); P; F; NONE; UF; HB-396
**Trifolium campestre* Schreb. (field clover); A; F; NONE; DA; HB-311
**Trifolium repens* L. (white clover); P; F; FACU; DA; HB-290
Vicia minutiflora D. Dietr. (smallflower vetch); A; F; FAC; DA; HB-306

Fagaceae
Quercus falcata Michx. (southern red oak); P; T; FACU; UF; HB-201
†*Quercus incana* W. Bartram (bluejack oak); P; T; NONE; UF; HB-XXX; S2G5
Quercus lyrata Walter (overcup oak); P; T; OBL; FPFA, QPQNF; HB-229
Quercus macrocarpa Michx. (bur oak); P; T; FACU; QPQNF, UF; HB-053
Quercus nigra L. (water oak); P; T; FAC; QPQNF; HB-149
Quercus phellos L. (willow oak); P; T; FACW; QPQNF; HB-028
Quercus stellata Wangenh (post oak); P; T; UPL; UF; HB-196

Quercus velutina Lam. (black oak); P; T; NONE; UF; HB-370

Gentianaceae
Sabatia angularis (L.) Pursh (squarestem rosegentian); A; F; FACW; DA; HB-389

Geraniaceae
Geranium carolinianum L. (Carolina geranium); A; F; NONE; DA; HB-320
Geranium texanum (Trel.) A. Heller (Texas geranium); A; F; NONE; DA; HB-253

Heliotropiaceae
**Heliotropium indicum* L. (India heliotrope); A; F; FAC; HWV, FPFA; HB-204

Hypericaceae
Hypericum gymnanthum Engelm. & A. Gray (claspingleaf St. Johnswort); P; F; FACW; HWV, FPFA; HB-208
Hypericum hypericoides (L.) Crantz (St. Andrew's cross); P; F; FAC; QPQNF, UF; HB-073
Hypericum punctatum Lam. (spotted St. Johnswort); P; F; FAC; QPQNF; HB-346

Iridaceae
Sisyrinchium angustifolium Mill. (blue-eyed grass); P; F; FACW; FPFA; HB-321

Juglandaceae
Carya cordiformis (Wangenh.) K. Koch (bitternut hickory); P; T; FAC; QPQNF, UF; HB-339
Carya ovata (Mill.) K. Koch (shagbark hickory); P; T; FACU; UF; HB-010
Carya texana Buckle (black hickory); P; T; NONE; UF; HB-381
Juglans nigra L. (black walnut); P; T; UPL; UF; HB-154

Juncaceae
Juncus bufonius L. (toad rush); A; G; FACW; DA; HB-260
Juncus coriaceus Mack. (leathery rush); P; G; FACW; FPFA; HB-015
Juncus diffusissimus Buckley (slimpod rush); P; G; FACW; FPFA; HB-045
Juncus effusus L. (common rush); P; G; OBL; DSHA, FPFA; HB-050
Juncus marginatus Rostk. (grassleaf rush); P; G; FACW; DSHA, FPFA; HB-033
Juncus scirpoides Lam. (needlepod rush); P; G; FACW; FPFA; HB-041
Juncus tenuis Willd. (field rush); P; G; FAC; QNQPF, UF; HB-006
Juncus validus Coville (roundhead rush); P; G; FACW; FPFA; HB-380

Lamiaceae
Callicarpa americana L. (American beautyberry); P; S; FACU; UF; HB-060
Lycopus virginicus L. (Virginia bugleweed); P; F; OBL; FPFA; HB-130
Monarda punctata L. (spotted beebalm); A; F; FACU; UF; HB-070
Monarda russeliana Nutt. ex Sims (redpurple beebalm); P; F; NONE; UF; HB-292
**Perilla frutescens* (L.) Britton (beefsteak plant); A; F; FACU; QPQNF, UF; HB-205
†*Physostegia intermedia* (Nutt.) Engelm. & A. Gray (slender false dragonhead); P; F; FACW; FPFA; HB-295; S1G5
Prunella vulgaris L. (heal all); P; F; FAC; QPQNF; HB-393
Pycnanthemum albescens Torr. & A. Gray (whiteleaf mountainmint); P; F; FAC; UF; HB-080

Pycnanthemum tenuifolium Schrad. (narrowleaf mountainmint); P; F; FACW; UF; HB-438
Salvia lyrata L. (lyreleaf sage); P; F; FACU; QPQNF, UF; HB-283
†*Scutellaria cardiophylla* Engelm. & A. Gray (gulf skullcap); A; F; FAC; UF; HB-017; S1G4?
Scutellaria lateriflora L. (mad dog skullcap); P; F; OBL; FPFA; HB-411
Stachys hispida Pursh (smooth hedgenettle); P; F; FACW; FPFA; HB-383
Teucrium canadense L. (Canada germander); P; F; FACW; DSHA, HWV; HB-024
Trichostema dichotomum L. (forked bluecurls); A; F; UPL; UF; HB-137

Lauraceae
Sassafras albidum (Nutt.) Nees (sassafras); P; T; FACU; UF; HB-344

Linderniaceae
Lindernia dubia (L.) Pennell (yellowseed false pimpernel); A; F; OBL; FPFA, HWV; HB-032

Lythraceae
Rotala ramosior (L.) Koehne (lowland toothcup); A; F; OBL; HWV; HB-047

Malvaceae
Sida spinosa L. (prickly sida); A; F; FACU; DA; HB-417

Melastomataceae
Rhexia mariana L. var. *interior* (Pennell) Kral & Bostick (Maryland meadowbeauty); P; F; NONE; DA; HB-129

Menispermaceae
Cocculus carolinus (L.) DC. (redberry moonseed); P; F; FAC; QPQNF; HB-390

Molluginaceae
**Glinus lotoides* L. (damascisa); A; F; FACW; HWV; HB-441
Mollugo verticillata L. (green carpetweed); A; F; FAC; DA, HWV; HB-207

Montiaceae
Claytonia virginica L. (springbeauty); P; F; FACU; QPQNF, UF; HB-101

Moraceae
Maclura pomifera (Raf.) C.K. Schneid. (osage orange); P; T; FACU; QPQNF, UF; HB-046
Morus rubra L. (red mulberry); P; T; FACU; QPQNF, UF; HB-374

Nyssaceae
Nyssa sylvatica Marshall (black gum); P; T; FAC; QPQNF; HB-058

Oleaceae
†*Forestiera acuminata* (Michx.) Poir. (swamp privet); P; S; OBL; FPFA; HB-256; S2G5
Fraxinus pennsylvanica Marsh. (green ash); P; T; FAC; FPFA; HB-054

Onagraceae
Ludwigia alternifolia L. (bushy seedbox); P; F; OBL; HWV; HB-180
Ludwigia decurrens (DC.) Walter (wingleaf waterprimrose); P; F; OBL; DSHA, HWV; HB-213

Ludwigia palustris (L.) Elliott (marsh seedbox); P; F; OBL; HWV; HB-128
Oenothera laciniata Hill (cut-leaved evening primrose); P; F; FACU; DA; HB-271

Onocleaceae
Onoclea sensibilis L. (sensitive fern); P; F; FACW; HWV; HB-131

Ophioglossaceae
Botrychium dissectum Spreng (cutleaf grapefern); P; F; FAC; QPQNF, UF; HB-234

Orchidaceae
†*Hexalectris spicata* (Walter) Barnhart (crested coralroot); P; F; FACU; UF; HB-398; S1G5

Orobanchaceae
Pedicularis canadensis L. (Canadian lousewort); P; F; FACU; UF; HB-397

Osmundaceae
Osmunda regalis L. (royal fern); P; F; NONE; DSHA; HB-061

Oxalidaceae
Oxalis dillenii Jacq. (Dillen's oxalis); P; F; FACU; DA, UF; HB-002
Oxalis violacea L. (violet woodsorrel); P; F; NONE; UF; HB-094

Papaveraceae
Corydalis micrantha (Engelm. ex A. Gray) A. Gray ssp. *australis* (Chapm.) G.B. Ownbey (smallflower fumewort); A; F; NONE; QPQNF; HB-087
Corydalis micrantha (Engelm. ex A. Gray) A. Gray ssp. *micrantha* (smallflower fumewort); A; F; NONE; QPQNF; HB-251

Passifloraceae
Passiflora incarnata L. (purple passionflower); P; F; NONE; QPQNF; HB-226

Penthoraceae
Penthorum sedoides L. (ditch stonecrop); P; F; OBL; FPFA, HWV; HB-072

Phrymaceae
Mimulus alatus Aiton (sharpwing monkeyflower); P; F; OBL; HWV; HB-214
Phryma leptostachya L. (American lopseed); P; F; FACU; UF; HB-062

Phyllanthaceae
Phyllanthus caroliniensis Walter (Carolina leafflower); A; F; FAC; HWV; HB-176

Pinaceae
Pinus echinata Mill. (shortleaf pine); P; T; NONE; UF; HB-387

Plantaginaceae
Gratiola virginiana L. (roundfruit hedgehyssop); A; F; OBL; HWV; HB-160
Penstemon arkansanus Pennell (Arkansas beardtongue); P; F; NONE; UF; HB-267
†*Penstemon murrayanus* Hook (scarlet beardtongue); P; F; NONE; UF; HB-274; S1G4

Plantago aristata Michx. (largebracted plantain); A; F; NONE; DA; HB-354
Plantago pusilla Nutt. (wooly Indian wheat); A; F; FACU; DA; HB-265
Plantago rugelii Decne. (blackseed plantain); P; F; FACU; QPQNF; HB-113
Veronica peregrina L. (purslane speedwell); A; F; FAC; DA; HB-261

Platanaceae
Platanus occidentalis L. (American sycamore); P; T; FACW; FPFA; HB-147

Poaceae
Agrostis perennans (Walter) Tuck (upland bentgrass); P; G; FACU; QPQNF; HB-440
**Aira caryophyllea* L. (silvery hairgrass); A; G; FAC; DA, QPQNF; HB-309
Alopecurus carolinianus Walter (Carolina foxtail); A; G; FACW; FPFA; HB-281
Andropogon gerardii Vitman (big bluestem); P; G; FAC; UF; HB-427
Andropogon glomeratus (Walter) Britton, Sterns & Poggemb. (bushy bluestem); P; G; FACW; DSHA, HWV; HB-425
Andropogon ternarius Michx. (splitbeard bluestem); P; G; FACU; UF; HB-232
Andropogon virginicus L. (broomsedge bluestem); P; G; FAC; FPFA; HB-224
†*Aristida lanosa* Muhl. ex Elliott (woolysheath threeawn); P; G; NONE; UF; HB-421; S1G5
Arundinaria gigantea (Walter) Muhl. (giant cane); P; G; FACW; FPFA; HB-228
**Bromus catharticus* Vahl (rescuegrass); P; G; NONE; DA; HB-279
Bromus pubescens Muhl. ex Willd. (hairy woodland brome); P; G; FACU; UF; HB-307
Chasmanthium latifolium (Michx.) H.O. Yates (Indian woodoats); P; G; FAC; QPQNF; HB-027
Chasmanthium laxum (L.) H.O. Yates ssp. *laxum* (slender woodoats); P; G; FACW; QPQNF; HB-399
Chasmanthium laxum (L.) H.O. Yates ssp. *sessiliflorum* (Poir.) L.G. Clark (slender woodoats); P; G; FACW; QPQNF; HB-119
Cinna arundinacea L. (sweet woodreed); P; G; FACW; QPQNF; HB-230
Coleataenia anceps (Michx.) Soreng (beaked panicgrass); P; G; FAC; QPQNF, UF; HB-146
Coleataenia longifolia (Torr.) Soreng ssp. *rigidula* (Bosc ex Nees) Soreng (redtop panicgrass); P; G; FACU; QPQNF; HB-199
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark (tapered rosette grass); P; G; FAC; UF; HB-318
Dichanthelium dichotomum (L.) Gould (cypress panicgrass); P; G; FAC; QPQNF; HB-034
Dichanthelium laxiflorum (Lam.) Gould (openflower rosette grass); P; G; FAC; QPQNF; HB-402
Dichanthelium ovale (Elliott) Gould & C.A. Clark (eggleaf rosette grass); P; G; FACU; UF; HB-068
Dichanthelium polyanthes (Schult.) Mohlenbr. (roundseed panicgrass); P; G; NONE; FPFA; HB-009
Dichanthelium ravenelii (Scribn. & Merr.) Gould (Ravenel's rosette grass); P; G; FACU; UF; HB-317
Dichanthelium scoparium (Lam.) Gould (velvet panicum); P; G; FACW; DSHA, HWV; HB-111
Digitaria ciliaris (Retz.) Koeler (southern crabgrass); A; G; FACU; DA; HB-039
Echinochloa muricata (P. Beauv.) Fernald var. *microstachya* Wiegand (rough barnyard grass); A; G; FACW; HWV; HB-001
Echinochloa muricata (P. Beauv.) Fernald var. *muricata* (rough barnyard grass); A; G; FACW; HWV; HB-238
Elymus virginicus L. (Virginia wildrye); P; G; FAC; QPQNF; UF; HB-069
Eragrostis hirsuta (Michx.) Nees (bigtop lovegrass); P; G; FAC; UF; HB-405
Eragrostis intermedia Hitchc. (plains lovegrass); P; G; NONE; UF; HB-247
Eragrostis spectabilis (Pursh) Steud. (purple lovegrass); P; G; FACU; UF; HB-241
Eragrostis trichodes (Nutt.) Alph. Wood (sand lovegrass); P; G; NONE; UF; HB-170
Festuca paradoxa Desv. (clustered fescue); P; G; FAC; QPQNF; HB-308

Glyceria striata (Lam.) Hitchc. (fowl mannagrass); P; G; OBL; FPFA, HWV; HB-057
Gymnopogon ambiguus (Michx.) Britton, Sterns & Poggenb. (bearded skeletongrass); P; G; NONE; UF; HB-178
Hordeum pusillum Nutt.(little barley); A; G; FACU; DA; HB-297
Leersia oryzoides (L.) Sw. (rice cutgrass); P; G; OBL; FPFA, HWV; HB-250
Leersia virginica Willd. (white grass); P; G; FACW; FPFA; HB-023
**Lolium perenne* L. (perennial ryegrass); P; G; FACU; UF; HB-268
Muhlenbergia sobolifera (Muhl. ex Willd.) Trin. (rocky muhly); P; G; NONE; UF; HB-408
Panicum dichotomiflorum Michx (western witchgrass); A; G; FACW; FPFA, QPQNF; HB-216
†*Paspalum bifidum* (Bertol.) Nash (pitchfork crowngrass); P; G; FACW; FPFA; HB-400; S1G5
Paspalum notatum Alain ex Flüggé (Bahia grass); P; G; FACU; DA; HB-248
Paspalum repens P.J. Bergius (horsetail paspalum); A; G; OBL; HWV; HB-418
Paspalum setaceum Michx. var. *setaceum* (thin paspalum); P; G; FAC; UF; HB-003
**Poa annua* L. (annual bluegrass); A; G; FACU; DA, UF; HB-106
Poa sylvestris A. Gray (woodland bluegrass); P; G; FACW; FPFA; HB-335
†*Sacciolepis striata* (L.) Nash (American cupscale); P; G; OBL; FPFA, HWV; HB-056; S2G5
†*Sorghastrum elliottii* (C. Mohr) Nash (slender Indiangrass); P; G; NONE; UF; HB-426; S1G5
Sphenopholis intermedia (Rydb.) Rydb. (slender wedgescale); P; G; FAC; QPQNF; HB-362
Sphenopholis obtusata (Michx.) Scribn. (prairie wedgescale); P; G; FAC; QPQNF; HB-312
Tridens flavus (L.) Hitchc. (purpletop); P; G; FACU; UF; HB-081
Vulpia octoflora (Walter) Rydb. (pullout grass); A; G; FACU; DA, UF; HB-299

Polygalaceae
Polygala verticillata L. (whorled milkwort); A; F; UPL; UF; HB-021

Polygonaceae
Fallopia scandens (L.) Holub (climbing false buckwheat); P; F; NONE; QPQNF; HB-419
Persicaria hydropiperoides (Michx.) Small (swamp smartweed); P; F; OBL; DSHA, FPFA; HB-220
Persicaria lapathifolia (L.) Gray (curlytop knotweed); A; F; FACW; FPFA; HB-428
Persicaria pensylvanica (L.) M. Gómez (Pennsylvania smartweed); A; F; FACW; FPFA; HB-403
Persicaria punctata (Elliott) Small (dotted smartwed); A; F; OBL; FPFA, HWV; HB-042
Persicaria sagittata (L.) H. Gross (arrowleaf tearthumb); A; F; OBL; DSHA; HB-345
Persicaria virginiana (L.) Gaertn. (jumpseed); P; F; FAC; QPQNF; HB-078
Polygonum ramosissimum Michx. (bushy knotweed); A; F; FACU; DA; HB-126
**Rumex conglomeratus* Murray (sharpwing dock); P; F; FACW; QPQNF; HB-110
**Rumex crispus* L. (curly dock); P; F; FAC; QPQNF; HB-323
Rumex hastatulus Baldwin (heartwing dock); P; F; FACU; DA; HB-263

Polypodiaceae
Pleopeltis polypodioides (L.) E.G. Andrews & Windham (resurrection fern); P; F; FAC; UF; HB-433

Primulaceae
†*Hottonia inflata* Elliott (American featherfoil); A; F; OBL; FPFA; HB-342; S2G4
Samolus valerandi L. (seaside brookweed); P; F; OBL; FPFA, HWV; HB-294

Ranunculaceae
Myosurus minimus L. (tiny mousetail); A; F; FACW; QPQNF; HB-289
Ranunculus abortivus L. (littleleaf buttercup); P; F; FACW; HWV, QPQNF; HB-038

Rhamnaceae
Berchemia scandens (Hill) K. Koch (Alabama supplejack); P; V; FAC; FPFA, QPQNF; HB-165
Rhamnus caroliniana Walter (Carolina buckthorn); P; T; FACU; UF; HB-155

Roaceae
Geum canadense Jacq. (white avens); P; F; FAC; QPQNF; HB-112
Agrimonia rostellata Wallr. (woodland groovebur); P; F; FAC; QPQNF; HB-420
Crataegus spathulata Michx (littlehip hawthorn); P; S; FAC; QPQNF; HB-356
Crataegus viridis L. (green hawthorn); P; S; FACW; UF; HB-326
**Duchesnea indica* (Andrews) Focke (Indian strawberry); P; F; FACU; QPQNF; HB-156
Prunus mexicana S. Watson (Mexican plum); P; T; NONE; UF; HB-104
Rosa setigera Michx. (climbing rose); P; S; FACU; UF; HB-435
Rubus argutus Link (prickly Florida blackberry); P; S; FAC; FPFA, QPQNF; HB-293
Rubus trivialis Michx. (southern dewberry); P; S; FACU; QPQNF, UF; HB-363

Rubiaceae
Cephalanthus occidentalis L. (common buttonbush); P; S; OBL; FPFA, HWV; HB-413
Diodella teres (Walter) Small (poor joe); A; F; NONE; DA, UF; HB-141
Diodia virginiana L. (Virginia buttonweed); P; F; FACW; HWV; HB-071
Galium aparine L. (bedstraw); A; F; FACU; DA; HB-287
Galium circaezans Michx. (licorice bedstraw); P; F; FACU; QPQNF, UF; HB-116
Galium pilosum Aiton (hairy bedstraw); P; F; NONE; UF; HB-115
Houstonia pusilla Schoepf (tiny bluet); A; F; FACU; DA; HB-097

Rutaceae
Zanthoxylum clava-herculis L. (Hercules-club); P; T; FAC; UF, QPQNF; HB-067

Salicaceae
Salix nigra Marshall (black willow); P; T; OBL; FPFA; HB-239

Sapindaceae
Acer negundo L. (boxelder); P; T; FAC; FPFA, QPQNF; HB-351
Acer saccharinum L. (silver maple); P; T; FAC; FPFA, QPQNF; HB-349
**Cardiospermum halicacabum* L. (balloonvine); A; F; FAC; HWV; HB-132

Sapotaceae
Sideroxylon lanuginosum Michx. (gum bully); P; T; FACU; UF; HB-187

Scrophulariaceae
Scrophularia marilandica L. (carpenter's square); P; F; FAC; QPQNF; HB-401
**Verbascum thapsus* L. (wooly mullein); B; F; FACU; DA; HB-012

Smilacaceae
Smilax bona-nox L. (saw greenbrier); P; V; FAC; DA, QPQNF; HB-386
Smilax glauca Walter (sawbrier); P; V; FAC; QPQNF; HB-048
Smilax rotundifolia L. (roundleaf greenbrier); P; V; FAC; QPQNF; HB-151

Solanaceae
Physalis heterophylla Nees (clammy groundcherry); P; F; NONE; UF; HB-384
Physalis virginiana Mill. (Virginia groundcherry); P; F; NONE; UF; HB-005
Solanum carolinense L. (Carolina horsenettle); P; F; FACU; UF; HB-314
Solanum ptychanthum Dunal (West Indian nightshade); A; F; FACU; QPQNF; HB-055

Tetrachondraceae
Polypremum procumbens L. (juniper-leaf); A; F; FACU; DA; HB-030

Ulmaceae
†*Planera aquatica* J.F. Gmel. (waterelm); P; T; OBL; FPFA; HB-350; S2G5
Ulmus alata Michx. (winged elm); P; T; FACU; UF; HB-175
Ulmus crassifolia Nutt. (cedar elm); P; T; FAC; QPQNF; HB-222
Ulmus rubra Muhl (slippery elm); P; T; FAC; QPQNF; HB-185

Urticaceae
Boehmeria cylindrica (L.) Sw. (small-spike false nettle); P; F; FACW; DSHA, FPFA; HB-190
Parietaria pensylvanica Muhl. ex Willd. (Pennsylvania pellitory); A; F; FAC; QPQNF; HB-022
Pilea pumila (L.) A. Gray (Canada clearweed); A; F; FACW; FPFA; HB-412
†*Urtica chamaedryoides* Pursh (heartleaf nettle); A; F; FAC; FPFA; HB-085; S3G4G5

Valerianaceae
Valerianella radiata (L.) Dufr. (beaked cornsalad); A; F; FAC; DA; HB-277

Verbenaceae
Glandularia canadensis (L.) Nutt. (rose mock vervain); P; F; NONE; UF; HB-105
Phyla lanceolata (Michx.) Greene (lanceleaf frogfruit); P; F; OBL; HWV; HB-035
Verbena halei Small (slender verbena); P; F; NONE; DA; HB-310
Verbena urticifolia L. (white verbena); P; F; FAC; FPFA, QPQNF; HB-044

Violaceae
Viola bicolor Pursh (field pansy); A; F; FAC; DA; HB-100
Viola pubescens Aiton (downy yellow violet); P; F; FACU; QPQNF; HB-086
Viola sagittata Aiton (arrow-leaved violet) P; F; FACW; FPFA, QPQNF; HB-258
Viola sororia Willd. (common blue violet); P; F; FAC; QPQNF; HB-092

Vitaceae
Ampelopsis arborea (L.) Koehne (peppervine); P; V; FAC; QPQNF, UF; HB-074
Ampelopsis cordata Michx. (heartleaf peppervine); P; V; FAC; QPQNF; HB-197
Parthenocissus quinquefolia (L.) Planch. (Virginia creeper); P; V; FACU; QPQNF, UF; HB-347
Vitis palmata Vahl (catbird grape); P; V; FACW; FPFA; HB-376
Vitis riparia Michx. (riverbank grape); P; V; FACW; FPFA; HB-194
Vitis rotundifolia Michx. (muscadine); P; V; FAC; QPQNF; HB-348

Woodsiaceae
Woodsia obtusa (Spreng.) Torr. (bluntlobe cliff fern); P; F; NONE; UF; HB-059

A FLORISTIC INVENTORY OF THE NATURE CONSERVANCY'S OKA' YANAHLI PRESERVE, JOHNSTON COUNTY, OKLAHOMA

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ABSTRACT

This paper reports the results of a vascular plant inventory at The Nature Conservancy's Oka' Yanahli Preserve in Johnston County, Oklahoma. A total of 645 taxa in 109 families were collected. Three-hundred and ninety genera, 602 species, and 43 infraspecific taxa were identified. The families with the largest number of taxa were the Asteraceae with 91 taxa and the Poaceae with 89 taxa. Ninety non-native or naturalized taxa—14.0% of the preserve's flora—were found. Nine taxa tracked by the Oklahoma Natural Heritage Inventory were present. Nine vegetation types occurred at the preserve.

Keywords: vascular, non-native, tracked, grassland

INTRODUCTION AND STUDY AREA

Dedicated in 2012, The Nature Conservancy's Oka' Yanahli Preserve was acquired with the goal of conserving biodiversity through land protection and stewardship. The preserve includes two miles along the Blue River, one of only two free-flowing rivers in the state of Oklahoma. Sustained by the Arbuckle-Simpson aquifer, this 227 km-long tributary of the Red River has some of the highest quality water in the state and is home to 82 native fish species, 23 mussel species, and one plant of global conservation concern. Current projects at the preserve include the restoration of streams and floodplain forests, the reintroduction of fire to the landscape, the management of invasive species, and the advancement of understanding of the Arbuckle-Simpson aquifer system.

Oka' Yanahli occupies 1,456 ha in Johnston County in south-central Oklahoma approximately 25 km north of the city of Tishomingo (Figure 1). The property is bisected by the Blue River, with the majority of the Preserve (1,445 ha) lying to its west. Latitudinal extent ranges from 34.419449 to 34.457549 and longitudinal extent from -96.622765 to -96.697415. Physiographically, the site is located within the Arbuckle Plains geomorphic province, consisting of plains and rolling hills on limestones of Ordovician age (Curtis et al. 2008; Johnson 2008). Soils are of the Kiti-

Shidler-Lula type, and are shallow, rocky, silty, clayey and humus-rich (Carter and Gregory 2008). Climate is classified as humid subtropical (Cfa) – temperate with no discernible dry season and with hot summers (Köppen 1884). The lowest average temperature (4.7°C) is in January, and the highest average temperature (28.2°C) is in July (Oklahoma Climatological Survey 2018). Mean annual temperature is 17°C (Oklahoma Climatological Survey 2018). May is the wettest month, with an average precipitation of 14.1 cm (Oklahoma Climatological Survey 2018). The growing season averages 220 days (Oklahoma Climatological Survey 2018). Elevation ranges from 289 – 335 m. The dominant potential vegetation type is tallgrass prairie (Duck and Fletcher 1943). Prior to its purchase, the property was used for cattle ranching.

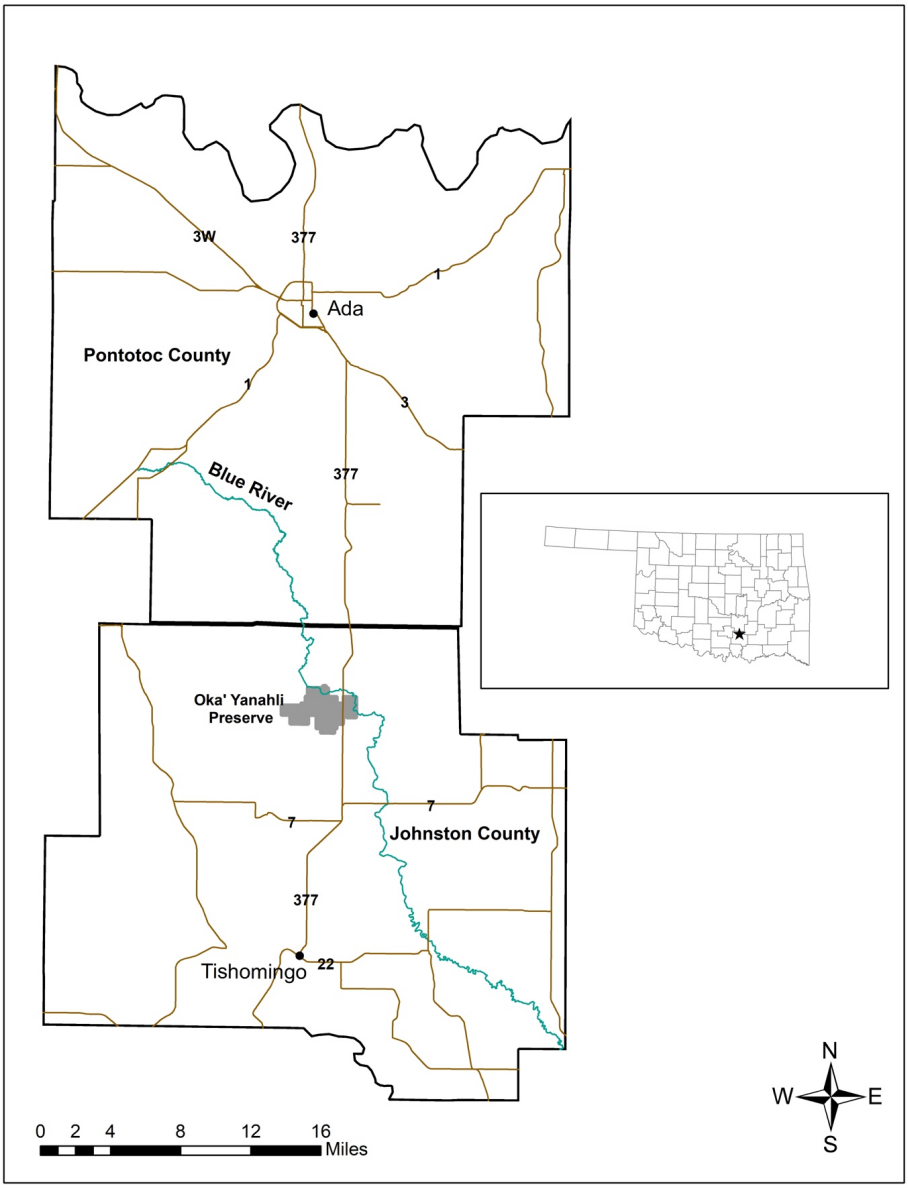

Figure 1 The Nature Conservancy's Oka' Yanahli Preserve.

METHODS

Vouchers of vascular plant taxa encountered at the Oka' Yanahli Preserve were made throughout the growing seasons (March through October) of 2014 – 2017. Specimens with flowers or fruit were preferred, but when they could not be found, sterile specimens were taken. Vouchers of planted taxa and taxa not native to the United States were collected only from naturalized populations. All specimens were pressed in a plant press, dried in a drying cabinet, and frozen at -20° before taken into the herbarium for identification and label generation. Manuals used for identification included Diggs et al. (1999) and Tyrl et al. (2015). Identifications were verified by comparison with specimens from the Robert Bebb Herbarium (OKL) at the University of Oklahoma. Duration, growth habit, wetland status, and nativity were determined using the PLANTS database (USDA-NRSC 2019) and Taylor and Taylor (1991). Vegetation classifications were based on Hoagland (2000). Classification and nomenclature follow the Angiosperm Phylogeny Group IV (Stevens 2001 onwards) and the Integrated Taxonomic Information System (2019). All specimens were deposited at OKL.

RESULTS AND DISCUSSION

A total of 645 taxa in 109 families were collected (Appendix). Five of these families were ferns and allies, two were magnoliids/primitive angiosperms, 17 were monocots, and 84 were eudicots. There was one family of gymnosperms (Table 1). Three hundred and ninety genera, 602 species, and 43 infraspecific taxa were identified. Four hundred and five taxa were perennials; there were 234 annuals and six biennials. Four hundred and twenty-eight of these taxa were forbs, 145 were graminoids, 39 were trees, 20 were shrubs, and 13 were woody vines. The families with the largest number of taxa were the Asteraceae with 91 taxa and the Poaceae with 89 taxa, and the genus with the most species was *Carex* in the Cyperaceae family. Ninety taxa, or 14.0% of the flora, were planted and naturalized or non-native to the United States. This percentage is high when compared to the floras of other Oklahoma sites dominated by grasslands (Table 2). The families with the most exotic taxa present were the Poaceae with 24 and Fabaceae with 16. The genus with the greatest number of exotics was *Trifolium* in the Fabaceae – five species were found. Nine species tracked by the Oklahoma Natural Heritage Inventory (2019) occurred at the preserve (Table 3), including the imperiled *Alnus maritima* (Betulaceae) (Figure 2). Obligate and facultative wetland taxa comprised 22.0% of the flora, with 69 obligate wetland and 74 facultative wetland taxa present. One hundred and fourteen taxa were classified as facultative, 149 were facultative upland taxa, and 29 were upland taxa. Two hundred and ten taxa had no wetland status.

Table 1 Summary of the floristic survey performed at the Oka' Yanahli Nature Preserve by divisions/groups and resulting number of taxa

Groups	Families	Genera	Total Taxa	Total Taxa Composition	Native Taxa	Nonnative Taxa	Nonnative Taxa Composition %
Ferns and Allies	5	6	6	0.9%	6	0	0
Gymnosperms	1	1	1	0.2%	1	0	0
Magnoliids/Primitive Angiosperms	2	2	2	0.3%	2	0	0
Monocots	17	87	176	27.3%	149	27	4.2%
Eudicots	84	294	460	71.3%	397	63	9.8%
TOTAL	109	390	645	100	555	90	14.0%

Table 2 Comparison of exotic taxa from the Oka' Yanahli site with other Oklahoma grassland-dominated sites.

Study site	Reference	Size of site (ha)	Number of taxa found	Percentage of non-native taxa
Oka' Yanahli Preserve, Johnston County	This paper	1,456.0	645	14.0 %
Pontotoc Ridge Nature Preserve, Johnston and Pontotoc Counties	Buthod, Hoagland, and Tucker, manuscript in preparation	848.2	616	8.8%
Kessler Atmospheric and Ecological Field Station, McClain County	Buthod and Hoagland 2016	146.0	388	14.7%
Tulsa Botanic Garden, Osage County	Hoagland and Buthod 2007	69.0	293	15.0%
Tallgrass Prairie Preserve, Osage County	Palmer 2007	15,410.0	763	12.1%
Camp Kickapoo Boy Scout Camp, Canadian County	Hoagland and Buthod 2006	64.7	334	12.3%
Selman Living Laboratory, Woodward County	Buckallew and Caddell 2003	129.5	229	9.0%

Table 3 Taxa located during this study that are tracked by the Oklahoma Natural Heritage Inventory (Oklahoma Natural Heritage Inventory 2019). Status ranks are on a 1-5 scale, with a 1 indicating the taxon is critically imperiled. G ranks are at the global level, and S ranks are at the subnational or state level. A question mark (?) denotes an inexact numeric rank (NatureServe Explorer 2021).

Family	Taxon	Rank
Betulaceae	*Alnus maritima* (Marshall) Muhl. ex Nutt.	S2G3
Elatinaceae	*Bergia texana* (Hook.) Seub. ex Walp.	S2G5
Fabaceae	*Styphnolobium affine* (Torr. & A. Gray) Walp.	S3G4
Gentianaceae	*Centaurium texense* (Griseb.) Fernald	S1G4?
Loganiaceae	*Mitreola petiolata* (J.F. Gmel.) Torr. & A. Gray	S1G4G5
Marsileaceae	*Marsilea vestita* Hook. & Grev.	S3G5
Primulaceae	*Lysimachia quadriflora* Sims	S1G5?
Rosaceae	*Poteridium annuum* (Nutt.) Spach	S1G4
Urticaceae	*Urtica chamaedryoides* Pursh	S3G4G5

Figure 2 *Alnus maritima* (Betulaceae; seaside alder) on the Blue River at the Oka' Yanahli Nature Preserve.

Nine vegetation types were found at Oka' Yanahli, six of which were named associations recognized by Hoagland (2000). Grassland types dominated – three types were found. Two forest associations, one woodland association, one shrubland association, and two types associated with moist soils also occurred at the preserve. These vegetation types are not discrete, however; they intergrade, with many taxa found in more than one vegetation type.

The primary vegetation type at Oka' Yanahli was classified as **disturbed area/old field (DAOF).** This vegetation type was found on deeper soils around houses, barns, and outbuildings, as well as areas heavily impacted by livestock activity. Common species included four species of ragweed – *Artemisia artemisiifolia* (annual ragweed), *A. bidentata* (lanceleaf ragweed), *A. psilostachya* (western ragweed), and *A. trifida* (giant ragweed). Native grasses, such as *Bothriochloa laguroides* (silver beardgrass), *Sorghastrum nutans* (Indiangrass), and *Tridens flavus* (purpletop tridens), were interspersed with non-natives such as *Bothriochloa ischaemum* (yellow bluestem), *Cynodon dactylon* (Bermudagrass), and *Schedonorus arundinaceus* (tall fescue). Much of the western half of the preserve is disturbed area/old field. With proper management, these areas would support a *Schizachyrium scoparium-Sorghastrum nutans* (little bluestem-Indiangrass) herbaceous association.

Another grassland type found at the preserve was the ***Bouteloua hirsuta-B. curtipendula*** **(hairy grama-sideoats grama) herbaceous association (BHBCHA)**. This grassland type occurred in upland areas with coarse or shallow soils. Taxa found in these areas included *Bouteloua dactyloides* (buffalo grass), *Heliotropium tenellum* (pasture heliotrope), *Monarda clinopodioides* (basil beebalm), and *Ophioglossum engelmannii* (limestone adderstongue). This vegetation type was the second most predominant type at the preserve.

A third grassland type was the ***Muhlenbergia reverchonii-Croton monathogynus*** **(seep muhly-prairie tea) herbaceous association (MRCMHA)**. This vegetation type was found on seasonal seepy areas over clay and calcareous soils. Common associated species included *Evolvulus nuttallianus* (shaggy dwarf morning-glory), *Hypoxis hirsuta* (common goldstar), *Physaria ovalifolia* ssp. *alba* (roundleaf bladderpod), *Phyllanthus polygonoides* (smartweed leaf-flower), *Tetraneuris linearifolia* (fineleaf fournerved daisy), and *Tragia ramosa* (nettle-leaf noseburn). This vegetation type is unique to Oklahoma.

Forest vegetation included the ***Quercus macrocarpa-Q. shumardii-Carya cordiformis*** **(bur oak-Shumard oak-bitternut hickory) association (QMQSCCFA)**. This vegetation type was found in mesic areas and in floodplains. Taxa common to this vegetation type included *Cercis canadensis* (eastern redbud), *Cornus drummondii* (roughleaf dogwood), *Smilax bona-nox* (saw greenbrier), and *Solidago ulmifolia* (elmleaf goldenrod).

The ***Ulmus rubra-Celtis laevigata-Fraxinus pensylvanica-F. americana*** **(slippery elm-sugarberry-green ash-white ash) forest association (URCLFPFAFA)** was also present at the preserve. This vegetation type was found in riparian areas in wet or mesic soils and included taxa such as *Chasmanthium latifolium* (Indian wood-oats), *Commelina virginica* (*Virginia dayflower*), *Elephantopus carolinianus* (Carolina elephantsfoot), *Quercus muehlenbergii* (chinkapin oak), and *Toxicodendron radicans* (eastern poison ivy).

Isolated pockets of the ***Quercus stellata-Q. marilandica-C. cordiformis*** **(post oak-blackjack oak- bitternut hickory) woodland association (QSQMCCWA)** were found in the southern part of the preserve. These were restricted to very rocky areas and included species such as *Quercus macrocarpa* (bur oak), *Sideroxylon lanuginosum* (gum bully),

Symphoricarpos orbiculatus (coralberry), and *Ulmus alata* (winged elm).

Vegetation types associated with wet soils included the **vegetation of seeps (SEEP)**. This type was found in areas that are typically wetter than those supporting the seep muhly-prairie tea herbaceous association. Associated taxa included *Andropogon glomeratus* (bushy bluestem), *Fuirena simplex* (western umbrella-sedge), *Lysimachia quadriflora* (fourflower yellow loosestrife), *Nasturtium officinale* (watercress), and *Rudbeckia fulgida* (orange coneflower). Two large seeps are found on Oka' Yanahli.

Herbaceous wetland vegetation (HWV) included plants found in and around ponds, creeks, depressions, and culverts. Taxa encountered at these sites included *Eleocharis obtusa* (blunt spikerush), *Heteranthera limosa* (blue mudplantain), *Iva annua* (sumpweed), *Nuphar advena* (yellow pond-lily) and *Salix nigra* (black willow).

The most significant vegetation type found at Oka' Yanahli was the ***Alnus maritima-Amorpha fruticosa*** **(seaside alder-false indigo) shrubland association (AMAFSA)**. This unusual vegetation type is only found in the Blue River drainage in Pontotoc and Johnston Counties in Oklahoma (NatureServe 2021). Growing in cobble bars and riparian areas, this association included taxa such as *Conoclinium coelestinum* (mist flower), the invasive *Iris pseudoacorus* (paleyellow iris), *Justicia americana* (American water-willow), *Leersia virginica* (whitegrass), and *Lobelia cardinalis* (cardinal flower). At Oka' Yanahli, this vegetation type intergraded with the slippery elm-sugarberry-green ash-white ash forest association.

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APPENDIX

List of vascular plant taxa from the Oka' Yanahli Nature Preserve, Johnston County, Oklahoma.

Taxa list with duration, growth habit, wetland status, vegetation type, nativity, and heritage status. A=annual, B=biennial, P=perennial; T=tree, S=shrub, V=woody vine, F=forb, G=graminoid; OBL=obligate wetland, FACW= facultative wetland, FAC=facultative, FACU=facultative upland, UPL=obligate upland, none=no wetland status; AMAFSA=*Alnus maritima-Amorpha fruticosa* shrubland association, BHBCHA=*Bouteloua hirsuta-B. curtipendula* herbaceous association, DAOF=disturbed area/old field, HWV=herbaceous wetland vegetation, MRCMHA=*Muhlenbergia reverchonii-Croton monathogynus* herbaceous association, QMQSCCFA=*Quercus macrocarpa-Q. shumardii-Carya cordiformis* forest association, QSQMCCWA=*Quercus stellata-Quercus marilandica-Carya cordiformis* woodland association, SEEP=vegetation of seeps, URCLFPFAFA=*Ulmus rubra-Celtis laevigata-Fraxinus pennsylvanica-Fraxinus americana* forest association.

Exotic taxa are denoted with an asterisk (*). Taxa tracked by the Oklahoma Natural Heritage Inventory are denoted with a dagger (†). Duration, growth habit, and nativity were determined using the PLANTS Database (USDA-NRCS 2019); if the information from PLANTS was ambiguous, Taylor and Taylor (1991), was consulted. Wetland status and common names were taken from PLANTS (USDA-NRCS 2019), and vegetation classifications were based on Hoagland (2000). Specimens were assigned collection numbers with the prefix OK, OKW, or AB. Voucher specimens were deposited at the Robert Bebb Herbarium of the University of Oklahoma (OKL).

Acanthaceae
Dicliptera brachiata (Pursh) Spreng. (branched foldwing); A; F; FACW; URCLFPFAFA; OK-314
Justicia americana (L.) Vahl (American water-willow); P; F; OBL; AMAFSA, HWV; OK-158
Ruellia humilis Nutt. (low ruellia); P; F; FAC; BHBCHA, DAOF; OK-339
Ruellia strepens L. (limestone wild petunia); P; F; FAC; URCLFPFAFA; OK-076

Adoxaceae
Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli (common elderberry); P; S; FAC; URCLFPFAFA; OK-120
Viburnum rufidulum Raf. (rusty blackhaw); P; S; FACU; QMQSCCFA; OK-235

Alismataceae
Alisma subcordatum Raf. (American water plantain); P; F; OBL; SEEP; OK-302
Echinodorus berteroi (Spreng.) Fassett (upright burrhead); P; F; OBL; HWV; OKW-005
Sagittaria brevirostra Mack. & Bush (shortbeak arrowhead); P; F; OBL; HWV; OKW-161
Sagittaria lancifolia L. (bulltongue arrowhead); P; F; OBL; AMAFSA; OK-383

Amaranthaceae
**Amaranthus albus* L. (prostrate pigweed); A; F; FACU; DAOF; OKW-165
Amaranthus tuberculatus (Moq.) J.D. Sauer (roughfruit amaranth); A; F; FAC; AMAFSA, DAOF, HWV; OK-083
**Chenopodium album* L. (lambsquarters); A; F; FACU; DAOF; OKW-193
Chenopodium pratericola Rydb. (desert goosefoot); A; F; none; DAOF; OK-441
Chenopodium standleyanum Aellen (Standley's goosefoot); A; F; none; DAOF; OK-443

**Amaryllidaceae*Dysphania ambrosioides* (L.) Mosyakin & Clemants (Mexican tea); A; F; FAC; DAOF; OK-447
Froelichia floridana (Nutt.) Moq. (cottonweed); A; F; none; DAOF; OKW-229
Iresine rhizomatosa Standl. (Juda's bush); P; F; FACW; URCLFPFAFA; OK-320

Amaryllidaceae
Allium canadense L. var. *fraseri* Ownbey (Fraser meadow garlic); P; F; FACU; DAOF; OK-375
Nothoscordum bivalve (L.) Britton (crow-poison); P; F; FACU; DAOF; OK-261
Zephyranthes chlorosolen (Herb.) D. Dietr. (evening rainlily); P; F; FAC; BHBCHA; OK-201

Anacardiaceae
Rhus aromatica Aiton (aromatic sumac); P; S; UPL; BHBCHA; OKW-088
Toxicodendron radicans (L.) Kuntze (eastern poison ivy); P; V; FACU; URCLFPFAFA; OKW-049

Apiaceae
Ammoselinum butleri (Engelm. ex S. Watson) J.M. Coult. & Rose (Butler's sandparsley); A; F; FAC; DAOF; OK-284
Bifora americana Benth. & Hook. f. ex S. Watson (prairie bishop's weed); A; F; none; MRCMHA; OK-207
Chaerophyllum tainturieri Hook. var. *tainturieri* (hairyfruit chervil); A; F; none; DAOF, MRCMHA; OK-521
Cicuta maculata L. (water hemlock); P; F; OBL; URCLFPFAFA; OK-122
Cryptotaenia canadensis (L.) DC. (Canadian honewort); P; F; FAC; URCLFPFAFA; OKW-024
Daucus pusillus Michx. (American wild carrot); A; F; none; DAOF; OK-121
Eryngium leavenworthii Torr. & A. Gray (Leavenworth's eryngo); A; F; none; BHBCHA; OK-294
Limnosciadium pinnatum (DC.) Mathias & Constance (tansy dogshade); A; F; FACW; HWV; OKW-217
Lomatium foeniculaceum (Nutt.) J.M. Coult. & Rose ssp. *daucifolium* (Torr. & A. Gray) W.L. Theob. (desert biscuitroot); P; F; none; BHBCHA; OKW-089
Polytaenia nuttallii DC. (Nuttall's prairie parsley); P; F; none; BHBCHA, DAOF; OK-099
Ptilimnium nuttallii (DC.) Britton (Nuttall's mockbishopweed); A; F; FACW; BHBCHA, MRCMHA; OK-161
Sanicula canadensis L. (snakeroot); B; F; FACW; QMQSCCFA; OK-192
Spermolepis divaricata (Benth. & Hook. f. ex S. Watson) Raf. ex Ser. (roughfruit scaleseed); A; F; FACW; BHBCHA; OK-392
**Torilis arvensis* (Huds.) Link (spreading hedgeparsley); A; F; none; DAOF; OK-185
**Torilis nodosa* (L.) Gaertn. (knotted hedgeparsley); A; F; none; DAOF; OKW-113
Zizia aurea (L.) W.D.J. Koch (golden zizia); P; F; FAC; URCLFPFAFA; OK-129

Apocynaceae
Apocynum cannabinum L. (Indianhemp); P; F; FAC; DAOF, SEEP; OK-109
Asclepias asperula (Decne.) Woodson ssp. *capricornu* (Woodson) Woodson (spider antelopehorn); P; F; none; MRCMHA; OK-479
Asclepias viridiflora Raf. (green comet milkweed); P; F; none; BHBCHA; OKW-035
Asclepias viridis Walter (green antelopehorn); P; F; none; DAOF; OK-174
Gonolobus suberosus (L.) R. Br. var. *suberosus* (angularfruit milkvine); P; F; FACW; QMQSCCFA; OK-391
Matelea biflora (Raf.) Woodson (twoflower milkvine); P; F; none; BHBCHA; OK-298

Aquifoliaceae
Ilex decidua Walter (deciduous holly); P; S; FAC; QMQSCCFA; OK-445

Araceae
Arisaema dracontium (L.) Schott (green dragon); P; F; FACW; URCLFPFAFA; OK-474
Spirodela polyrrhiza (L.) Schleid. (common duckmeat); P; F; OBL; HWV; OKW-156

Aristolochiaceae
Aristolochia tomentosa Sims (woolly dutchman's pipe); P; F; FAC; URCLFPFAFA; OK-256

Asparagaceae
Androstephium coeruleum (Scheele) Greene (blue funnel lily); P; F; none; BHBCHA; OKW-086
**Asparagus officinalis* L. (garden asparagus); P; F; FACU; DAOF; OK-478
Camassia angusta (Engelm. & A. Gray) Blank. (prairie camas); P; F; none; BHBCHA; OKW-060
**Muscari botryoides* (L.) Mill. (common grape hyacinth); P; F; none; DAOF; OKW-097
Polygonatum biflorum (Walter) Elliott (smooth Solomon's seal); P; F; FACU; URCLFPFAFA; OK-191
Yucca arkansana Trel. (Arkansas yucca); P; F; none; DAOF; OK-548

Aspleniaceae
Asplenium resiliens Kunze (blackstem spleenwort); P; F; none; URCLFPFAFA; OKW-093

Asteraceae
Achillea millefolium L. (common yarrow); P; F; FACU; DAOF; OK-008
Ageratina altissima (L.) King & H. Rob. (white snakeroot); P; F; UPL; URCLFPFAFA; OK-446
Ambrosia artemisiifolia L. (annual ragweed); A; F; FACU; DAOF; OKW-175
Ambrosia bidentata Michx. (lanceleaf ragweed); A; F; none; DAOF; OK-254
Ambrosia psilostachya DC. (western ragweed); A; F; FACU; BHBCHA, DAOF; OK-032
Ambrosia trifida L. (giant ragweed); A; F; FAC; DAOF; OK-315
Amphiachyris dracunculoides (DC.) Nutt. (prairie broomweed); A; F; none; DAOF; OK-004
**Arctium minus* Bernh. (lesser burdock); B; F; FACU; DAOF; OKW-225
Arnoglossum plantagineum Raf. (groovestem Indian plantain); P; F; FAC; BHBCHA, DAOF; OK-169
Artemisia ludoviciana Nutt. (white sagebrush); P; F; UPL; BHBCHA; OKW-040
Astranthium ciliatum (Raf.) G.L. Nesom (entireleaf western daisy); A; F; none; BHBCHA; OKW-085
Bidens bipinnata L (Spanish needles); A; F; FACU; URCLFPFAFA; OKW-163
Bidens frondosa L. (devil's beggartick); A; F; FACW; AMAFSA, URCLFPFAFA; OK-044
**Carduus nutans* L. (nodding plumeless thistle); B; F; FACU; DAOF; OK-167
Chaetopappa asteroides Nutt. ex DC. (Arkansas leastdaisy); A; F; none; MRCMHA; OK-477
Cirsium altissimum (L.) Hill (tall thistle); B; F; none; DAOF; OK-321
Cirsium engelmannii Rydb. (Engelmann's thistle); P; F; none; DAOF; OK-100
Cirsium undulatum (Nutt.) Spreng. (wavyleaf thistle); P; F; FACU; DAOF; OK-216
Conoclinium coelestinum (L.) DC. (mist flower); P; F; FACW; AMAFSA, URCLFPFAFA; OK-020
Conyza canadensis (L.) Cronquist (Canadian horseweed); A; F; none; DAOF; OK-293
Conyza ramosissima Cronquist (dwarf horseweed); A; F; none; DAOF; OKW-181
Coreopsis grandiflora Hogg ex Sweet (largeflower tickseed); P; F; none; BHBCHA; OK-389
Coreopsis lanceolata L. (tickweed); P; F; FACU; MRCMHA; OK-536
Coreopsis tinctoria Nutt. (golden tickseed); A; F; FAC; DAOF; OK-217
Diaperia prolifera Nutt. ex DC. (bighead pygmycudweed); A; F; none; DAOF; OK-513

Eclipta prostrata (L.) L. (false daisy); A; F; FACW; HWV; OK-251
Elephantopus carolinianus Raeusch. (Carolina elephantsfoot); P; F; FAC; QMQSCCFA; OK-073
Engelmannia peristenia (Raf.) Goodman & C.A. Lawson (Engelmann's daisy); P; F; none; BHBCHA; OK-135
Erechtites hieraciifolius (L.) Raf. ex DC. (fireweed); A; F; none; URCLFPFAFA; OK-015
Erigeron philadelphicus L. (Philadelphia fleabane); P; F; FAC; AMAFSA; OK-273
Erigeron strigosus Muhl. ex Willd. (prairie fleabane); A; F; FACU; DAOF; OK-154
Eupatorium perfoliatum L. (common boneset); P; F; FACW; SEEP; OK-250
Eupatorium serotinum Michx. (lateflowering thoroughwort); P; F; FAC; DAOF; OK-250
Gaillardia pulchella Foug. (Indian blanket); A; F; UPL; BHBCHA; OK-136
Gamochaeta pensylvanica (Willd.) Cabrera (Pennsylvania everlasting); A; F; UPL; DAOF; OKW-099
Gamochaeta purpurea (L.) Cabrera (spoonleaf purple everlasting); P; F; FACU; DAOF; OK-095
Grindelia lanceolata Nutt. (narrowleaf gumweed); P; F; none; BHBCHA; OKW-190
Helenium amarum (Raf.) H. Rock (bitterweed); A; F; FACU; DAOF; OK-003
Helianthus annuus L. (common sunflower); A; F; FACU; DAOF; OK-401
Helianthus hirsutus Raf. (hairy sunflower); P; F; none; QMQSCCFA; OK-493
Helianthus maximiliani Schrad. (Maximilian sunflower); P; F; FACU; DAOF; OK-440
Helianthus tuberosus L. (Jerusalem artichoke); P; F; FACU; URCLFPFAFA; OK-563
Heliopsis helianthoides (L.) Sweet (smooth oxeye); P; F; FACU; URCLFPFAFA; OKW-012
Heterotheca subaxillaris (Lam.) Britton & Rusby (camphorweed); A; F; FACU; UPL; BHBCHA; OKW-176
Hymenopappus scabiosaeus L'Hér. var. *corymbosus* (Torr. & A. Gray) B.L. Turner (Carolina woolywhite); B; F; none; DAOF; OK-368
Iva angustifolia Nutt. ex DC. (narrowleaf marshelder); A; F; none; DAOF; OK-562
Iva annua L. (sumpweed); A; F; FAC; HWV; OK-028
Krigia caespitosa (Raf.) K.L. Chambers (weedy dwarfdandelion); A; F; FACU; BHBCHA; OKW-110
Krigia occidentalis Nutt. (western dwarfdandelion); A; F; none; DAOF; OK-283
Lactuca ludoviciana (Nutt.) Riddell (western wild lettuce); A; F; FACU; URCLFPFAFA; OK-204
**Lactuca serriola* L. (prickly lettuce); A; F; FACU; DAOF; OKW-034
Liatris punctata Hook. var. *mucronata* (DC.) B.L. Turner (densespike blazingstar); P; F; none; BHBCHA; OKW-152
Lindheimera texana A. Gray & Engelm. (Texas yellow star); A; F; none; MRCMHA; OK-480
Marshallia caespitosa Nutt. ex DC. (Barbara's buttons); P; F; FAC; BHBCHA; OK-173
Packera glabella (Poir.) C. Jeffrey (butterweed); A; F; FACW; BHBCHA; OKW-125
Packera obovata (Muhl. ex Willd.) W.A. Weber & A. Löve (roundleaf ragwort); P; F; FACU; AMAFSA; OK-264
Packera plattensis (Nutt.) W.A. Weber & A. Löve (prairie groundsel); P; F; FACU; BHBCHA; OKW-090
**Parthenium hysterophorus* L. (Santa Maria feverfew); A; F; FAC; DAOF; OK-030
Plectocephalus americanus (Nutt.) D. Don (American star-thistle); A; F; none; BHBCHA; OKW-031
Pluchea odorata (L.) Cass. (sweetscent); A; F; FACW; HWV; OKW-167
Pyrrhopappus grandiflorus (Nutt.) Nutt. (tuberous desert-chicory); P; F; none; BHBCHA; OKW-137
Pyrrhopappus pauciflorus (D. Don) DC. (smallflower desert-chicory); A; F; none; MRCMHA; OK-212
Ratibida columnifera (Nutt.) Woot. & Standl. (yellow coneflower); P; F; none; DAOF; OK-327
Rudbeckia amplexicaulis Vahl (clasping coneflower); A; F; FAC; BHBCHA; OK-138
Rudbeckia fulgida Aiton (orange coneflower); P; F; FAC; SEEP; OK-068
Rudbeckia hirta L. (blackeyed Susan); P; F; FACU; DAOF; OK-106
Rudbeckia laciniata L. (cutleaf coneflower); P; F; FAC; AMAFSA; OK-340

Rudbeckia triloba L. (browneyed Susan); P; F; FACU; URCLFPFAFA; OK-400
Silphium integrifolium Michx. (wholeleaf rosinweed); P; F; FAC; DAOF; OK-554
Silphium laciniatum L. (compassplant); P; F; none; DAOF; OK-219
Silphium radula Nutt. var. *radula* (Reverchon's rosinweed); P; F; none; DAOF; OK-555
Smallanthus uvedalia (L.) Mack. ex Small (hairy leafcup); P; F; none; URCLFPFAFA; OK-317
Solidago altissima L. ssp. *gilvocanescens* (Rydb.) Semple (prairie goldenrod); P; F; FACU; BHBCHA, DAOF; OK-434
Solidago gigantea Aiton (giant goldenrod); P; F; FAC; SEEP; OK-432
Solidago rigida L. ssp. *rigida* (stiff goldenrod); P; F; FACU; DAOF; OK-424
Solidago ulmifolia Michx. ex Willd. (elmleaf goldenrod); P; F; none; QMQSCCFA; OK-433
**Sonchus asper* (L.) Hill (spiny sowthistle); A; F; FAC; DAOF; OK-208
Symphyotrichum drummondii (Lindl.) G.L. Nesom var. *texanum* (E.S. Burgess) G.L. Nesom (blue wood aster); P; F; none; QMQSCCFA; OK-428
Symphyotrichum ericoides (L.) G.L. Nesom var. *ericoides* (white heath aster); P; F; FACU; DAOF; OK-023
Symphyotrichum lanceolatum (Willd.) G.L. Nesom var. *lanceolatum* (white panicle aster); P; F; FACW; QMQSCCFA; OK-430
Symphyotrichum oolentangiense (Riddell) G.L. Nesom (skyblue aster); P; F; none; URCLFPFAFA; OKW-220
Symphyotrichum praealtum (Poir.) G.L. Nesom (willowleaf aster); P; F; FACW; DAOF; OK-429
Symphyotrichum subulatum (Michx.) G.L. Nesom (salt marsh aster); P; F; OBL; DAOF, HWV; OK-059
**Taraxacum officinale* F.H. Wigg. (common dandelion); P; F; FACU; DAOF; OK-462
Tetraneuris linearifolia (Hook.) Greene (fineleaf fournerved daisy); A; F; none; MRCMHA; OK-182
Thelesperma filifolium (Hook.) A. Gray (stiff greenthread); P; F; none; BHBCHA; OKW-064
Verbesina alternifolia (L.) Britton ex Kearney (wingstem); P; F; FAC; QMQSCCFA; OK-074
Verbesina virginica L. (Virginia crownbeard); P; F; FACU; URCLFPFAFA; OK-316
Vernonia baldwinii Torr. (Baldwin's ironweed); P; F; FACU; DAOF; OK-061
Vernonia missurica Raf. (Missouri ironweed); P; F; FACW; SEEP; OK-553
Xanthium strumarium L. (rough cocklebur); A; F; FAC; HWV; OK-031

Berberidaceae
Podophyllum peltatum L. (mayapple); P; F; FACU; QMQSCCFA; OK-128

Betulaceae
†*Alnus maritima* (Marshall) Muhl. ex Nutt. (seaside alder); P; S; OBL; AMAFSA; OKW-173; S2G3

Bignoniaceae
Campsis radicans (L.) Seem. ex Bureau (trumpet creeper); P; V; FACU; QMQSCCFA; OK-131

Boraginaceae
Lithospermum incisum Lehm. (narrowleaf puccoon); P; F; none; DAOF; OK-262
Myosotis verna Nutt. (spring forget-me-not); A; F; FAC; BHBCHA, QMQSCCFA; OK-465

Brassicaceae
**Capsella bursa-pastoris* (L.) Medik. (shepherd's purse); A; F; FACU; DAOF; OK-465
Cardamine parviflora L. (sand bittercress); A; F; FACW; DAOF; OK-281
**Chorispora tenella* (Pall.) DC. (crossflower); A; F; none; DAOF; OKW-084

**Descurainia sophia* (L.) Webb ex Prantl (herb sophia); A; F; none; DAOF; OKW-080
Draba brachycarpa Nutt. ex Torr. & A. Gray (shortpod draba); A; F; none; DAOF; OK-279
Draba reptans (Lam.) Fernald (Carolina draba); A; F; none; BHBCHA; OKW-094
**Lepidium densiflorum* Schrad. (common pepperweed); A; F; FAC; DAOF; OK-367
**Nasturtium officinale* W.T. Aiton (watercress); P; F; OBL; SEEP; OK-019
Physaria gracilis (Hook.) O'Kane & Al-Shehbaz (spreading bladderpod); A; F; FACW; AMAFSA; OK-265
Physaria ovalifolia (Rydb.) O'Kane & Al-Shehbaz ssp. *alba* (Goodman) O'Kane & Al-Shehbaz (roundleaf bladderpod); P; F; none; BHBCHA; OK-543
Physaria ovalifolia (Rydb.) O'Kane & Al-Shehbaz ssp. *ovalifolia* (roundleaf bladderpod); P; F; none; MRCMHA; OKW-209
Rorippa palustris (L.) Besser (bog yellowcress); A; F; OBL; HWV; OK-387
Rorippa sessiliflora (Nutt.) Hitchc. (stalkless yellowcress); A; F; OBL; HWV; OKW-196
**Sisymbrium officinale* (L.) Scop. (hedgemustard); A; F; none; DAOF; OK-097
**Thlaspi arvense* L. (field pennycress); A; F; FACU; DAOF; OKW-051

Cactaceae
Echinocereus reichenbachii (Terscheck ex Walp.) J.N. Haage (lace hedgehog cactus); P; F; none; BHBCHA, MRCHHA; OKW-144
Opuntia humifusa (Raf.) Raf. (devil's tongue); P; S; none; DAOF; OK-549
Opuntia phaeacantha Engelm. (tulip pricklypear); P; S; none; BHBCHA; OKW-219

Campanulaceae
Lobelia cardinalis L. (cardinalflower); P; F; FACW; AMAFSA; OK-009
Lobelia siphilitica L. (great blue lobelia); P; F; OBL; SEEP; OK-086
Triodanis leptocarpa (Nutt.) Nieuwl. (western Venus' lookingglass); A; F; none; DAOF; OK-374
Triodanis perfoliata (L.) Nieuwl. ssp. *biflora* (Ruiz & Pav.) Lammers (clasping Venus' looking glass); A; F; FAC; MRCMHA; OK-484

Cannabaceae
Celtis laevigata Willd. (sugarberry); P; T; FAC; URCLFPFAFA; OK-277

Caprifoliaceae
**Lonicera japonica* Thunb. (Japanese honeysuckle); P; V; FACU; SEEP; OK-163
Symphoricarpos orbiculatus Moench (coralberry); P; S; FACU; BHBCHA; OKW-042

Caryophyllaceae
**Arenaria serpyllifolia* L. (thymeleaf sandwort); A; F; FACU; DAOF; OK-200
Cerastium brachypodum (Engelm. ex A. Gray) B.L. Rob. (shortstalk chickweed); P; F; FACU; DAOF; OK-286
**Cerastium glomeratum* Thuill. (sticky chickweed); A; F; FACU; DAOF; OK-289
**Cerastium pumilum* W. Curtis (European chickweed); A; F; none; DAOF; OK-288
**Dianthus armeria* L. (Deptford pink); A; F; UPL; DAOF; OKW-213
Minuartia drummondii (Shinners) McNeill (Drummond's stitchwort); A; F; none; BHBCHA; OKW-120
Minuartia michauxii (Fenzl) Farw. (rock sandwort); A; F; none; MRCMHA; OK-540
Minuartia patula (Michx.) Mattf. (pitcher's stitchwort); A; F; FAC; DAOF; OK-287
Paronychia virginica Spreng. (yellow nailwort); P; F; none; BHBCHA; OK-394

Silene antirrhina L. (sleepy catchfly); A; F; none; BHBCHA, DAOF; OK-518
Silene stellata (L.) W.T. Aiton (widowsfrill); P; F; none; QMQSCCFA; OK-255
**Stellaria media* (L.) Vill. (common chickweed); A; F; FACU; AMAFSA, URCLFPFAFA; OK-270

Celastraceae
Celastrus scandens L. (American bittersweet); P; V; UPL; SEEP; OK-350

Cleomaceae
Polanisia dodecandra (L.) DC. (redwhisker clammyweed); A; F; FACU; BHBCHA; OKW-010

Commelinaceae
Commelina erecta L. (whitemouth dayflower); P; F; FACU; BHBCHA, DAOF; OK-231
Commelina virginica L. (Virginia dayflower); P; F; FAC; AMAFSA, URCLFPFAFA; OK-331
Tradescantia ohiensis Raf. (Ohio spiderwort); P; F; FACU; BHBCHA; OKW-216

Convolvulaceae
Convolvulus equitans Benth. (Texas bindweed); P; F; FACU; BHBCHA, MRCMHA; OK-139
Cuscuta indecora Choisy var. *indecora* (showy dodder); P; F; none; BHBCHA; OK-497
Dichondra carolinensis Michx. (Carolina ponysfoot); P; F; FAC; DAOF; OKW-218
Evolvulus nuttallianus Schult. (shaggy dwarf morning-glory); P; F; none; MRCMHA; OK-152
**Ipomoea hederacea* Jacq. (ivyleaf morning-glory); A; F; FAC; AMAFSA; OK-436
Ipomoea lacunosa L. (whitestar); A; F; FACW; AMAFSA; OK-038

Cornaceae
Cornus drummondii C.A. Mey. (roughleaf dogwood); P; T; FACQ; MQSCCFA; OK-522

Crassulaceae
Sedum nuttallii Torr. & E. James ex Eaton (yellow stonecrop); A; F; none; BHBCHA; OKW-133
Sedum pulchellum Michx. (widowscross); A; F; FACU; BHBCHA, MRCMHA; OK-148

Cucurbitaceae
Cucurbita foetidissima Kunth (buffalo gourd); P; F; none; DAOF; OK-490
**Cucurbita pepo* L. (gourd); A; F; none; AMAFSA; OK-060
Melothria pendula L. (Guadeloupe cucumber); P; F; FAC; DAOF; OK-036
Sicyos angulatus L. (oneseed burr cucumber); A; F; FACW; AMAFSA, URCLFPFAFA; OK-398

Cupressaceae
Juniperus virginiana L. (eastern redcedar); P; T; UPL; QMQSCCFA; OKW-183

Cyperaceae
Carex albicans Willd. ex Spreng. (whitetinge sedge); P; G; FACU; QMQSCCFA; OK-461
Carex aureolensis Steud. (goldenfruit sedge); P; G; none; AMAFSA; OK-408
Carex blanda Dewey (eastern woodland sedge); P; G; FAC; QMQSCCFA; OK-409
Carex brevior (Dewey) Mack. (shortbeak sedge); P; G; FAC; BHBCHA; OKW-150
Carex bulbostylis Mack. (false hair sedge); P; G; FACW; QSQMCCWA; OKW-199
Carex bushii Mack. (Bush's sedge); P; G; OBL; DAOF; OK-546
Carex caroliniana Schwein. (Carolina sedge); P; G; OBL; QMQSCCFA; OKW-147

Carex cephalophora Muhl. ex Willd. (oval-leaf sedge); P; G; OBL; URCLFPFAFA; OK-410
Carex cherokeensis Schwein. (Cherokee sedge); P; G; FACW; QMQSCCFA; OK-237
Carex complanata Torr. & Hook. (hirsute sedge); P; G; FAC; URCLFPFAFA; OKW-151
Carex corrugata Fernald (prune-fruit sedge); P; G; FACW; URCLFPFAFA; OK-456
Carex emoryi Dewey (Emory's sedge); P; G; OBL; HWV; OKW-205
Carex festucacea Schkuhr ex Willd. (fescue sedge); P; G; FACW; URCLFPFAFA; OK-458
Carex frankii Kunth (Frank's sedge); P; G; OBL; HWV; OK-229
Carex granularis Muhl. ex Willd. (limestone meadow sedge); P; G; OBL; URCLFPFAFA; OK-550
Carex grisea Wahlenb. (inflated narrow-leaf sedge); P; G; FACW; URCLFPFAFA; OK-547
Carex leavenworthii Dewey (Leavenworth's sedge); P; G; none; URCLFPFAFA; OK-411
Carex microdonta Torr. & Hook. (littletooth sedge); P; G; OBL; DAOF; OK-415
Carex perdentata S.D. Jones (sand sedge); P; G; none; URCLFPFAFA; OK-457
Carex retroflexa Muhl. ex Willd. (knotsheath sedge); P; G; FACU; QMQSCCFA; OK-545
Carex vulpinoidea Michx. (fox sedge); P; G; FACW; HWV; OK-417
Cyperus acuminatus Torr. & Hook. ex Torr. (taperleaf flat sedge); P; G; OBL; HWV; OK-050
Cyperus echinatus (L.) Alph. Wood (globe flatsedge); P; G; FAC; DAOF; OK-329
Cyperus esculentus L. (chufa flatsedge); P; G; FACW; DAOF; OK-423
Cyperus lupulinus (Spreng.) Marcks (Great Plains flatsedge); P; G; FACU; DAOF; OK-559
Cyperus odoratus L. (fragrant flatsedge); P; G; FACW; HWV; OK-052
Cyperus retroflexus Buckley (oneflower flatsedge); P; G; none; QMQSCCFA; OK-498
Cyperus retrorsus Chapm. (pine barren flatsedge); P; G; FAC; DAOF; OKW-232
Cyperus setigerus Torr. & Hook. (lean flatsedge); P; G; FAC; SEEP; AB-12359
Cyperus squarrosus L. (bearded flatsedge); A; G; OBL; SEEP; OK-499
Cyperus strigosus L. (strawcolored flatsedge); P; G; FACW; SEEP; OK-087
Eleocharis acicularis (L.) Roem. & Schult. (needle spikerush); A; G; OBL; HWV; OKW-068
Eleocharis compressa Sull. var. *acutisquamata* (Buckley) S. G. Sm. (sharpscale spikerush); P; G; FACW; HWV; OK-404
Eleocharis engelmannii Steud. (Engelmann's spikerush); A; G; FACW; HWV; OK-414
Eleocharis montevidensis Kunth (sand spikerush); P; G; FACW; HWV, SEEP; OK-407
Eleocharis obtusa (Willd.) Schult. (blunt spikesedge); A; G; OBL; HWV; OK-051
Eleocharis palustris (L.) Roem. & Schult. (common spikerush); P; G; OBL; HWV; OK-094
Eleocharis parvula (Roem. & Schult.) Link ex Bluff, Nees & Schauer (dwarf spikerush); A; G; OBL; HWV; OKW-004
Eleocharis quadrangulata (Michx.) Roem. & Schult. (squarestem spikerush); P; G; OBL; HWV; OK-215
Fimbristylis puberula (Michx.) Vahl var. *puberula* (hairy fimbry); P; G; OBL; BHBCHA, DAOF; OK-515
Fuirena simplex Vahl (western umbrella-sedge); P; G; OBL; SEEP; OK-084
Isolepis carinata Hook. & Arn. ex Torr. (keeled bulrush); A; G; FACW; HWV; OK-516
Rhynchospora harveyi W. Boott (Harvey's beakrush); P; G; FAC; DAOF; OK-468
Schoenoplectus pungens (Vahl) Palla (common threesquare); P; G; OBL; SEEP; OK-202
Scirpus pendulus Muhl. (rufous bulrush); P; G; OBL; SEEP; OK-168
Scleria verticillata Muhl. ex Willd. (low nutrush); A; G; OBL; SEEP; OK-258

Ebenaceae
Diospyros virginiana L. (common persimmon); P; T; FAC; QMQSCCFA; OK-162

Elatinaceae
†*Bergia texana* (Hook.) Seub. ex Walp. (Texas bergia); P; F; OBL; HWV; OKW-162; S2G5

Euphorbiaceae

Acalypha monococca (Engelm. ex A. Gray) Lill. W. Mill. & Gandhi (slender threeseed mercury); A; F; none; BHBCHA; OKW-067
Acalypha ostryifolia Riddell (pineland threeseed Mercury); A; F; none; QMQSCCFA; OK-248
Acalypha rhomboidea Raf. (Virginia threeseed Mercury); A; F; FACU; URCLFPFAFA; OK-039
Acalypha virginica L. (Virginia threeseed Mercury); A; F; FACU; URCLFPFAFA; OKW-036
Croton capitatus Michx. (wooly croton); A; F; none; DAOF; OK-246
Croton monanthogynus Michx. (prairie tea); A; F; none; DAOF; OK-007
Ditaxis mercurialina (Nutt.) J.M. Coult. (tall silverbush); P; F; none; BHBCHA; OKW-018
Euphorbia cyathophora Murray (fire on the mountain); A; F; UPL; URCLFPFAFA; OK-399
Euphorbia dentata Michx. (toothed spurge); A; F; none; URCLFPFAFA; OK-045
Euphorbia maculata L. (spotted sandmat); A; F; FACU; DAOF; OK-056
Euphorbia missurica Raf. (prairie sandmat); A; F; none; BHBCHA; OKW-164
Euphorbia nutans Lag. (eyebane); A; F; FACU; BHBCHA; OK-296
Euphorbia spathulata Lam. (warty spurge); A; F; FACU; MRCMHA; OK-183
Stillingia sylvatica L. (queen's-delight); P; F; none; BHBCHA; OKW-009
Tragia ramosa Torr. (nettle-leaf noseburn); P; F; none; MRCMHA; OK-482

Fabaceae

Amorpha fruticosa L. (false índigo); P; S; FACW; AMAFSA; OK-178
Amphicarpaea bracteata (L.) Fernald (American hogpeanut); A; F; FACU; URCLFPFAFA; OKW-046
Apios americana Medik. (groundnut); P; F; FAC; SEEP; OK-292
Astragalus crassicarpus Nutt. (groundplum milkvetch); P; F; none; DAOF; OK-565
Astragalus nuttallianus DC. (Nuttall's milkvetch); P; F; none; MRCMHA; OK-539
Baptisia australis (L.) R. Br. (blue wild indigo); P; F; UPL; DAOF; OK-533
Baptisia bracteata Muhl. ex Elliott (longbract wild indigo); P; F; none; BHBCHA; OKW-079
Cercis canadensis L. (eastern redbud); P; T; UPL; QMQSCCFA; OK-274
Chamaecrista fasciculata (Michx.) Greene (partridge pea); A; F; FACU; DAOF; OK-221
Dalea aurea Nutt. ex Fraser (golden prairie clover); P; F; none; BHBCHA; OK-323
Dalea candida Michx. ex Willd. (white prairie clover); P; F; none; BHBCHA; OK-111
Dalea purpurea Vent. (violet prairie clover); P; F; none; BHBCHA; OK-140
Desmanthus illinoensis (Michx.) MacMill. ex B.L. Rob. & Fernald (prairie bundleflower); P; F; FACU; DAOF; OK-242
Desmanthus leptolobus Torr. & A. Gray (slenderlobe bundleflower); P; F; none; DAOF; OKW-222
Desmodium canescens (L.) DC. (hoary ticktrefoil); P; F; none; DAOF; OK-556
Desmodium glutinosum (Muhl. ex Willd.) Alph. Wood (pointedleaf ticktrefoil); P; F; none; URCLFPFAFA; OKW-027
Desmodium paniculatum (L.) DC. (panicled tickclover); P; F; UPL; DAOF; OK-421
Desmodium sessilifolium (Torr.) Torr. & A. Gray (sessileleaf ticktrefoil); P; F; none; BHBCHA; OKW-178
Desmodium tweedyi Britton (Tweedy's ticktrefoil); P; F; none; DAOF; OK-102
Galactia regularis (L.) Britton, Sterns & Poggenb. (eastern milkpea); P; F; none; URCLFPFAFA; OKW-014
Gleditsia triacanthos L. (honeylocust); P; T, FACU; QMQSCCFA; OK-337
Gymnocladus dioicus (L.) K. Koch (Kentucky coffeetree); P; T, none; QMQSCCFA; OK-531
**Kummerowia striata* (Thunb.) Schindl. (Japanese clover); A; F; UPL; DAOF; OK-347
**Lathyrus hirsutus* L. (Caley pea); A; F; FAC; DAOF; OK-098

**Lespedeza cuneata* (Dum. Cours.) G. Don (Chinese lespedeza); P; F; FACU; BHBCHA, DAOF; OKW-039
Lespedeza texana Britton ex Small (Texas lespedeza); P; F; none; DAOF; OK-564
Lespedeza virginica (L.) Britton (slender lespedeza); P; F; none; DAOF; OK-566
**Medicago arabica* (L.) Huds. (spotted medick); A; F; none; DAOF; OKW-100
**Medicago lupulina* L. (black medick); A; F; FACU; DAOF; OK-206
**Medicago minima* (L.) L. ex Bartal. (burr medick); A; F; none; DAOF; OK-351
**Melilotus albus* Medik. (sweetclover); A; F; FACU; DAOF; OK-502
**Melilotus officinalis* (L.) Lam. (yellow sweetclover); A; F; FACU; DAOF; OK-116
Mimosa nuttallii (DC. Ex Britton & Rose) B.L. Turner (Nuttall's sensitivebriar); P; F; none; DAOF; OK-373
Neptunia lutea (Leavenw.) Benth. (yellow puff); P; F; FACU; BHBCHA; OK-143
Psoralidium tenuiflorum (Pursh) Rydb. (slimflower scurfpea); P; F; none; BHBCHA; OK-146
Robinia pseudoacacia L. (black locust); P; T; UPL; DAOF; OKW-136
**Senna occidentalis* (L.) Link (septicweed); A; F; UPL; AMAFSA; OK-070
Strophostyles helvola (L.) Elliott (amberique-bean); A; F; FACU; AMAFSA; OK-396
Stylosanthes biflora (L.) Britton, Sterns & Poggenb. (sidebeak pencilflower); P; F; none; BHBCHA; OKW-025
†*Styphnolobium affine* (Torr. & A. Gray) Walp. (Eve's necklace); P; T; none; URCLFPFAFA; OK-108; S3G4
**Trifolium arvense* L. (rabbitfoot clover); A; F; none; DAOF; OK-528
**Trifolium campestre* Schreb. (field clover); A; F; none; DAOF; OK-365
**Trifolium repens* L. (white clover); P; F; FACU; DAOF; OK-175
**Trifolium resupinatum* (reversed clover); A; F; FACU; BHBCHA, DAOF; OKW-115
**Trifolium vesiculosum* Savi (arrowleaf clover); A; F; none; DAOF; OK-380
**Vicia sativa* L. (garden vetch); A; F; FACU; BHBCHA; OKW-071
**Vicia villosa* Roth var. *glabrescens* W.D.J. Koch (winter vetch); A; F; none; DAOF; OK-381

Fagaceae
Quercus macrocarpa Michx. (bur oak); P; T; FACU; QMQSCCFA; OK-013
Quercus marilandica Münchh. (blackjack oak); P; T; none; BHBCHA; OKW-098
Quercus muehlenbergii Engelm. (chinkapin oak); P; T; FAC; URCLFPFAFA; OK-006
Quercus shumardii Buckley (Shumard's oak); P; T; FAC; QMQSCCFA; OKW-032
Quercus stellata Wangenh. (post oak); P; T; FACU; BHBCHA; OKW-177
Quercus velutina Lam. (black oak); P; T; none; QMQSCCFA; OK-233

Gentianaceae
†*Centaurium texense* (Griseb.) Fernald (Lady Bird's centaury); A; F; none; MRCMHA; OK-213; S1G4?
Sabatia campestris Nutt. (meadow pink); A; F; FAC; BHBCHA, DAOF; OKW-226

Geraniaceae
**Erodium cicutarium* (L.) L'Hér. ex Aiton (redstem stork's bill); A; F; none; DAOF; OKW-112
Geranium carolinianum L. (Carolina crane's bill); A; F; none; DAOF; OK-181
**Geranium pusillum* L. (small geranium); A; none; F; DAOF; OKW-134
Geranium texanum (Trel.) A. Heller (Texas geranium); A; F; none; DAOF; OK-525

Grossulariaceae
Ribes aureum Pursh var. *villosum* DC. (golden currant); P; S; FACU; URCLFPFAFA; OKW-092

Haloragaceae
Myriophyllum heterophyllum Michx. (twoleaf watermilfoil); P; F; OBL; HWV; OK-422

Hamamelidaceae
**Liquidambar styraciflua* L. (sweetgum); P; T; FAC; DAOF; OKW-101

Heliotropiaceae
**Heliotropium indicum* L. (India heliotrope); A; F; FACW; AMAFSA; OK-005
Heliotropium tenellum (Nutt.) Torr. (pasture heliotrope); A; F; none; BHBCHA; OK-137

Hydrophyllaceae
Phacelia strictiflora (Engelm. & A. Gray) A. Gray (prairie phacelia); A; F; none; URCLFPFAFA; OKW-057

Hypericaceae
Hypericum sphaerocarpum Michx. (roundseed St. Johnswort); P; F; FACU; MRCMHA; OK-520

Hypoxiaceae
Hypoxis hirsuta (L.) Coville (common goldstar); P; F; FACW; MRCMHA; OK-153

Iridaceae
**Iris pseudacorus* L. (paleyellow iris); P; F; OBL; AMAFSA; OK-257
Sisyrinchium angustifolium Mill. (narrowleaf blue-eyed grass); P; F; FACW; BHBCHA, DAOF; OK-532

Juglandaceae
Carya cordiformis (Wangenh.) K. Koch (bitternut hickory); P; T; FACU; QMQSCCFA; OK-232
Carya illinoinensis (Wangenh.) K. Koch (pecan); P; T; FAC; URCLFPFAFA; OK-025
Juglans nigra L. (black walnut); P; T; FACU; QMQSCCFA; OK-011

Juncaceae
Juncus brachyphyllus Wiegand (tuftedstem rush); P; G; FAC; DAOF; OK-091
Juncus diffusissimus Buckley (slimpod rush); P; G; FACW; HWV; OK-055
Juncus filipendulus Buckley (ringseed rush); P; G; FAC; SEEP; OK-416
Juncus interior Wiegand (inland rush); P; G; FACW; BHBCHA; OKW-160
Juncus marginatus Rostk. (grassleaf rush); P; G; FACW; HWV; OK-238
Juncus nodatus Coville (stout rush); P; G; OBL; HWV; OK-227
Juncus tenuis Willd. (poverty rush); P; G; FAC; QMQSCCFA; OK-130
Juncus torreyi Coville (Torrey's rush); P; G; FACW; HWV; OK-223
Juncus validus Coville (roundhead rush); P; G; FACW; HWV; OK-466

Krameriaceae
Krameria lanceolata Torr. (trailing ratany); P; F; none; BHBCHA; OK-142

Lamiaceae
Clinopodium glabrum (Nutt.) Kuntze (limestone calamint); P; F; FAC; MRCMHA; OK-151

Hedeoma drummondii Benth. (Drummond's false pennyroyal); P; F; none; BHBCHA; OKW-139
Hedeoma hispida Pursh (rough false pennyroyal); P; F; none; MRCMHA; OK-363
**Lamium amplexicaule* L. (henbit deadnettle); A; F; none; DAOF; OK-259
**Lamium purpureum* L. (purple deadnettle); A; F; none; AMAFSA; OK-290
Lycopus americanus Muhl. ex W.P.C. Bartram (American bugleweed); P; F; OBL; SEEP; OK-066
Monarda clinopodioides A. Gray (basil beebalm); A; F; none; BHBCHA; OK-214
Monarda fistulosa L. (wild bergamot); P; F; UPL; BHBCHA; OKW-033
**Perilla frutescens* (L.) Britton (beefsteakplant); A; F; FAC; AMAFSA, URCLFPFAFA; OK-010
Physostegia intermedia (Nutt.) Engelm. & A. Gray (slender false dragonhead); P; F; OBL; HWV; OKW-223
Prunella vulgaris L. (common selfheal); P; F; FAC; URCLFPFAFA; OK-021
Pycnanthemum tenuifolium Schrad. (narrowleaf mountainmint); P; F; FAC; SEEP; OK-110
Salvia azurea Michx. ex Lam. (azure blue sage); P; F; none; BHBCHA; OKW-179
Scutellaria lateriflora L. (mad dog skullcap); P; F; OBL; SEEP; AB-12360
Scutellaria parvula Michx. var. *australis* Fassett (small skullcap); P; F; UPL; MRCMHA; OK-378
Stachys tenuifolia Willd. (slender betony); P; F; FACW; HWV; OKW-234
Teucrium canadense L. (American germander); P; F; FACW; AMAFSA; OK-218
Trichostema brachiatum L. (fluxweed); A; F; none; BHBCHA; OKW-159

Lentibulariaceae
Utricularia gibba L. (humped bladderwort); P; F; OBL; SEEP; OK-450

Liliaceae
Erythronium albidum Nutt. (white fawnlily); P; F; FACU; QMQSCCFA; OK-460

Linaceae
Linum medium (Planch.) Britton var. *texanum* (Planch.) Fernald (stiff yellow flax); A; F; FAC; DAOF; OK-504
Linum pratense (Norton) Small (meadow flax); A; F; none; MRCMHA; OK-535
Linum rigidum Pursh (stiffstem flax); A; F; none; BHBCHA, MRCMHA; OK-210

Linderniaceae
Lindernia dubia (L.) Pennell (yellowseed false pimpernel); A; F; OBL; HWV; OK-247

Loganiaceae
†*Mitreola petiolata* (J.F. Gmel.) Torr. & A. Gray (lax hornpod); A; F; FACW; SEEP; OK-085; S1G4G5

Lythraceae
Ammannia auriculata Willd. (eared redstem); A; F; OBL; HWV; OK-042
Ammannia coccinea Rottb. (valley redstem); A; F; OBL; HWV; OK-054
Lythrum alatum Pursh (winged lythrum); P; F; OBL; HWV; OK-326
Rotala ramosior L. Koehne (lowland rotala); A; F; none; HWV; OK-053

Malvaceae
**Abutilon theophrasti* Medik. (velvetleaf); A; F; UPL; DAOF; OK-252
Callirhoe alcaeoides (Michx.) A. Gray (pink poppy mallow); P; F; OBL; DAOF; OK-172
Callirhoe involucrata (Torr. & A. Gray) A. Gray (purple poppymallow); P; F; none; DAOF; OK-190

Callirhoe pedata (Nutt. ex Hook.) A. Gray (palmleaf poppymallow); P; F; none; MRCMHA; OK-481
Sida spinosa L. (prickly fanpetals); A; F; UPL; DAOF; OK-222

Marsileaceae
†*Marsilea vestita* Hook. & Grev. (hairy waterclover); P; F; OBL; HWV; OKW-003; S3G5

Menispermaceae
Cocculus carolinus (L.) DC. (Carolina coralbead); P; F; FACU; URCLFPFAFA; OK-037

Molluginaceae
**Glinus lotoides* L. (lotus sweetjuice); A; F; FACW; HWV; OKW-044
Mollugo verticillata L. (green carpetweed); A; F; FAC; DAOF; OK-033

Montiaceae
Claytonia virginica L. (Virginia springbeauty); P; F; FACU; DAOF, QMQSCCFA; OK-260
Phemeranthus parviflorus (Nutt.) Kiger (sunbright); P; F; none; BHBCHA; OKW-019

Moraceae
Maclura pomifera (Raf.) C.K. Schneid. (osage orange); P; T; FACU; DAOF; OK-176
**Morus alba* L. (white mulberry); P; T; FACU; DAOF; OK-552
Morus rubra L. (red mulberry); P; T; FACU; QMQSCCFA; OK-388

Najadaceae
Najas guadalupensis (Spreng.) Magnus (southern waternymph); A; F; OBL; HWV; OKW-157

Nyctaginaceae
Mirabilis nyctaginea (Michx.) MacMill. (heartleaf four o'clock); P; F; UPL; URCLFPFAFA; OK-187

Nymphaeaceae
Nuphar advena (Aiton) W. T. Aiton (yellow pond-lily); P; F; OBL; HWV; OK-184

Oleaceae
Forestiera pubescens Nutt. var. *pubescens* (elbowbush); P; S; FACU; MRCMHA; OK-523
Fraxinus americana L. (white ash); P; T; FACU; SEEP, URCLFPFAFA; OK-022
Fraxinus pennsylvanica Marsh. (green ash); P; T; FAC; URCLFPFAFA; OK-239
**Ligustrum quihoui* Carrière (waxyleaf privet); P; S; none; DAOF, QMQSCCFA; OK-062

Onagraceae
Ludwigia glandulosa Walter (cylindricfruit primrose-willow); P; F; OBL; HWV; OK-226
Ludwigia peploides (Kunth) P.H. Raven (floating primrose-willow); P; F; OBL; HWV; OK-386
Ludwigia repens J.R. Forst. (creeping primrose-willow); P; F; OBL; SEEP; OK-063
Oenothera berlandieri (Spach) Steud. ssp. *berlandieri* (Spach) Steud. (Berlandier's sundrops); P; F; none; BHBCHA; OK-395
Oenothera curtiflora W.L. Wagner & Hoch (velvety gaura); A; F; UPL; DAOF; OK-449
Oenothera filiformis (Small) W.L. Wagner & Hoch (longflower beeblossom); A; F; none; DAOF; OK-344
Oenothera glaucifolia W.L. Wagner & Hoch (false gaura); P; F; none; BHBCHA; OKW-172
Oenothera laciniata Hill (cutleaf evening-primrose); P; F; FACU; BHBCHA; OKW-077

Oenothera linifolia Nutt. (threadleaf evening-primrose); A; F; none; MRCMHA; OK-514
Oenothera macrocarpa Nutt. (bigfruit evening-primrose); P; F; none; BHBCHA, MRCMHA; OK-132
Oenothera spachiana Torr. & A. Gray (Spach's evening-primrose); A; F; none; BHBCHA; OKW-126
Oenothera suffulta (Engelm.) W.L. Wagner & Hoch (roadside gaura); A; F; none; BHBCHA, MRCMHA; OK-486
Oenothera triloba Nutt. (stemless evening primrose); A; F; none; BHBCHA, MRCMHA; OK-537

Ophioglossaceae
Botrychium virginianum (L.) Sw. (rattlesnake fern); P; F; FACU; URCLFPFAFA; OKW-043
Ophioglossum engelmannii Prantl; limestone adderstongue; P; F; FACU; BHBCHA; OKW-188

Orchidaceae
Spiranthes cernua (L.) Rich. (nodding lady's tresses); P; F; FACW; DAOF; OK-452
Spiranthes lacera (Raf.) Raf. var. *gracilis* (Bigelow) Luer (northern slender ladies'-tresses); P; F; FAC; DAOF; OK-431
Spiranthes magnicamporum Sheviak (Great Plains lady's tresses); P; F; FAC; SEEP; OK-453
Spiranthes vernalis Engelm. A. Gray (spring ladies'-tresses); P; F; FACW; BHBCHA; OKW-037

Orobanchaceae
Agalinis heterophylla (Nutt.) Small (prairie false foxglove); A; F; FAC; DAOF; OK-451
Castilleja indivisa Engelm. (Indian paintbrush); A; F; FAC; BHBCHA, DAOF; OK-141

Oxalidaceae
Oxalis corniculata L. (creeping woodsorrel); P; F; FACU; DAOF; OK-080
Oxalis violacea L. (violet woodsorrel); P; F; none; BHBCHA; OKW-109

Papaveraceae
Argemone polyanthemos (Fedde) G.B. Ownbey (crested pricklypoppy); A; F; none; BHBCHA; OKW 061

Passifloraceae
Passiflora incarnata L. (may-pop); P; F; none; DAOF; OK-491
Passiflora lutea L. (yellow passionflower); P; F; none; QMQSCCFA, URCLFPFAFA; OK-338

Penthoraceae
Penthorum sedoides L. (ditch stonecrop); P; F; OBL; AMAFSA; OKW-013

Phrymaceae
Mimulus alatus Aiton (sharpwing monkeyflower); P; F; OBL; AMAFSA; OK-035
Phryma leptostachya L. (American lopseed); P; F; FACU; QMQSCCFA; OK-125

Phyllanthaceae
Phyllanthus polygonoides Nutt. ex Spreng. (smartweed leaf-flower); P; F; none; MRCMHA; OK-145

Phytolaccaceae
Phytolacca americana L. (pokeweed); P; F; FACU; DAOF; OK-123

Plantaginaceae
Bacopa rotundifolia (Michx.) Wettst. (disk waterhyssop); P; F; OBL; HWV; OK-253
Callitriche heterophylla Pursh (greater waterstarwort); A; F; OBL; HWV; OKW-210
Gratiola neglecta Torr. (clammy hedgehyssop); A; F; OBL; HWV; OK-362
Gratiola virginiana L. (roundfruit hedgehyssop); A; F; OBL; HWV; OKW-204
Leucospora multifida (Michx.) Nutt. (narrowleaf paleseed); A; F; FACW; DAOF, HWV; OK-249
Nuttallanthus texanus (Scheele) D.A. Sutton (Texas toadflax); A; F; none; BHBCHA; OKW-075
Penstemon cobaea Nutt. var. *purpureus* Pennell (cobaea beardtongue); P; F; none; BHBCHA; OKW-145
Plantago aristata Michx. (bottlebrush plantain); A; F; none; MRCMHA; OK-366
Plantago elongata Pursh (prairie plantain); A; F; FACW; BHBCHA; OKW-081
Plantago rugelii Decne. (blackseed plantain); P; F; FACU; HWV; OKW-227
Plantago virginica L. (paleseed plantain); A; F; FACU; DAOF; OK-384
Plantago wrightiana Decne. (Wright's plantain); A; F; none; BHBCHA, MRCMHA; OKW-140
Veronica anagallis-aquatica L. (water speedwell); P; F; OBL; AMAFSA; OK-197
**Veronica arvensis* L. (corn speedwell); A; F; FACU; DAOF; OK-280
Veronica peregrina L. (purslane speedwell); A; F; FACW; DAOF; OK-276
**Veronica persica* Poir. (birdeye speedwell); A; F; none; AMAFSA, DAOF; OK-267

Platanaceae
Platanus occidentalis L. (American sycamore); P; T; FAC; DAOF, URCLFPFAFA; OK-332

Poaceae
**Aegilops cylindrica* Host (jointed goatgrass); A; G; none; DAOF; OK-115
Agrostis hyemalis (Walter) Britton, Sterns & Poggenb. (winter bentgrass); P; G; FACW; MRCMHA; OK-472
**Aira elegantissima* Schur (annual silver hairgrass); A; G; FACW; DAOF; OK-469
Alopecurus carolinianus Walter (Carolina foxtail); A; G; FACW; HWV; OK-155
Andropogon gerardii Vitman (big bluestem); P; G; FACU; BHBCHA; OK-297
Andropogon glomeratus (bushy bluestem); P; G; FACW; HWV, SEEP; OK-001
Andropogon ternarius Michx. (splitbeard bluestem); P; G; FACU; DAOF; OK-561
Andropogon virginicus L. (broomsedge bluestem); P; G; FACU; BHBCHA; OKW-180
Aristida oligantha Michx. (prairie threeawn); A; G; none; DAOF; OK-346
Aristida purpurea Nutt. var. *wrightii* (Nash) Allred (Wright's threeawn); P; G; none; MRCMHA; OK-485
Arundinaria gigantea (Walter) Muhl. (giant cane); P; G; FACW; URCLFPFAFA; OK-313
**Bothriochloa ischaemum* (L.) Keng (yellow bluestem); P; G; none; DAOF; OK-312
Bothriochloa laguroides (DC.) Herter (silver beardgrass); P; G; none; DAOF; OK-328
Bouteloua curtipendula (Michx.) Torr. (sideoats grama); P; G; none; BHBCHA; OK-492
Bouteloua dactyloides (Nutt.) Columbus (buffalo grass); P; G; FACU; BHBCHA; OK-133
Bouteloua hirsuta Lag. (hairy grama); P; G; none; BHBCHA; OK-299
Bouteloua rigidiseta (Steud.) Hitchc. (Texas grama); P; G; none; BHBCHA; OK-134
**Briza minor* L. (little quakinggrass); A; G; FAC; MRCMHA; OK-209
**Bromus catharticus* Vahl (resuce grass); A; G; none; DAOF; OK-188
Bromus pubescens Muhl. ex Willd. (hairy woodland brome); P; G; FACU; QMQSCCFA; OK-124
**Bromus racemosus* L. (bald brome); A; G; none; DAOF; OK-353
**Bromus sterilis* L. (poverty brome); A; G; none; BHBCHA; OKW-118
Cenchrus spinifex Cav. (coastal sandbur); P; G; none; BHBCHA; OKW-066

Chasmanthium latifolium (Michx.) H.O. Yates (Indian woodoats); P; G; FACU; URCLFPFAFA; OK-012
**Chloris verticillata* Nutt.; windmill grass; P; G; none; DAOF; OK-144
Coleataenia anceps (Michx.) Soreng (beaked panicgrass); P; G; FAC; URCLFPFAFA; OK-024
Coleataenia longifolia (Torr.) Soreng ssp. *rigidula* (Bosc ex Nees) Soreng (redtop panicgrass); P; G; FACU; HWV, SEEP; OK-018
**Cynodon dactylon* (L.) Pers. (Bermudagrass); P; G; FACU; DAOF; OK-322
**Dactylis glomerata* L.; orchardgrass; P; G; FACU; DAOF; OK-334
Diarrhena obovata (Gleason) Brandenburg (obovate beakgrain); P; G; FAC; URCLFPFAFA; OK-358
Dichanthelium aciculare (Desv. ex Poir.) Gould & C.A. Clark (needleleaf rosette grass); P; G; FACU; DAOF; OK-454
Dichanthelium acuminatum (Sw.) Gould & C. A. Glark var. *lindheimeri* (Nash) Gould & C.A. Clark (Lindheimer panicgrass); P; G; FAC; DAOF; OK-224
Dichanthelium laxiflorum (Lam.) Gould (openflower rosette grass); P; G; FAC; QMQSCCFA; OK-471
Dichanthelium linearifolium (Scribn.) Gould (slim-leaf rosette grass); P; G; none; QSQMCCWA; OKW-200
Dichanthelium malacophyllum (Nash) Gould (softleaf rosette grass); P; G; none; QMQSCCFA; OK-419
Dichanthelium oligosanthes (Schult.) Gould (Heller's rosette grass); P; G; FACU; DAOF; OK-081
Dichanthelium sphaerocarpon (Elliott) Gould (roundseed panicum); P; G; FACU; BHBCHA; OKW-149
Digitaria ciliaris (Retz.) Pers. (southern crabgrass); A; G; FACU; AMAFSA, DAOF; OK-078
Digitaria cognata (Schult.) Pilg. (Carolina crabgrass); P; G; none; BHBCHA; OKW-186
**Echinochloa crus-galli* (L.) P. Beauv. (barnyard grass); A; G; FAC; AMAFSA, HWV; OK-079
Echinochloa muricata (P. Beauv.) Fernald (rough barnyard grass); A; G; FACW; HWV; OK-047
**Eleusine indica* (L.) Gaertn. (Indian goosegrass); A; G; FACU; DAOF; OK-295
Elymus virginicus L. (Virginia wildrye); P; G; FAC; DAOF; OK-101
**Eragrostis barrelieri* Daveau (Mediterranean lovegrass); A; G; none; BHBCHA; OKW-065
**Eragrostis cilianensis* (Bellardi) Vignolo ex Janch. (stinkgrass); A; G; FACU; DAOF; OK-359
Eragrostis curtipedicellata Buckley (gummy lovegrass); P; G; none; BHBCHA, DAOF; OK-234
Eragrostis hirsuta (Michx.) Nees (bigtop lovegrass); P; G; FACU; BHBCHA; OKW-195
**Eragrostis pilosa* (L.) P. Beauv.; Indian lovegrass; A; G; FACU; BHBCHA, DAOF; OK-088
Erioneuron pilosum (Buckley) Nash (hairy woolygrass); P; G; none; MRCMHA; OK-487
Festuca subverticillata (Pers.) E.B. Alexeev (nodding fescue); P; G; FACU; QMQSCCFA; OK-356
Glyceria striata (Lam.) Hitchc. (fowl mannagrass); P; G; OBL; AMAFSA; OK-193
Hordeum pusillum Nutt. (little barley); A; G; FACU; DAOF; OK-159
Leersia oryzoides (L.) Sw. (rice cutgrass); P; G; OBL; AMAFSA; OK-075
Leersia virginica Willd. (whitegrass); P; G; FACW; AMAFSA; OK-319
Leptochloa fusca (L.) Kunth ssp. *fascicularis* (Lam.) N. Snow (bearded sprangletop); A; G; FACW; HWV; OKW-007
Leptochloa panicea (Retz.) Ohwi ssp. *mucronata* (Michx.) Nowack (mucronate sprangletop); A; G; FACW; AMAFSA, HWV; OK-043
**Lolium perenne* L. (perennial ryegrass); P; G; FACU; DAOF; OK-156
Mnesithea cylindrica (Michx.) de Koning & Sosef (cylinder jointtail grass); P; G; FAC; DAOF; OK-495
Muhlenbergia reverchonii Vasey & Scribn. (seep muhly); P; G; FAC; MRCMHA; OK-348
Muhlenbergia schreberi J.F. Gmel. (nimblewill); P; G; FACU; HWV; OKW-162
Muhlenbergia sobolifera (Muhl. ex Willd.) Trin.; rock muhly; P; G; none; QMQSCCFA; OK-082
Nassella leucotricha (Trin. & Rupr.) R.W. Pohl (Texas tussockgrass); P; G; none; BHBCHA, DAOF; OK-355
Panicum capillare L. (witchgrass); A; G; FAC; DAOF; OK-241

Panicum dichotomiflorum Michx. (fall panicgrass); A; G; FAC; DAOF; OK-057
Panicum philadelphicum Bernh. ex Trin. (Philadelphia panicgrass); A; G; FAC; DAOF; OK-361
Panicum virgatum L. (switchgrass); P; FAC; G; BHBCHA, DAOF; OK-300
Paspalum dilatatum Poir. (dallis grass); P; G; FAC; DAOF; OKW-224
**Paspalum distichum* Houtt. (knotgrass); P; G; FACW; DAOF; OK-092
Paspalum floridanum Michx. (Florida paspalum); P; G; FACW; DAOF; OK-058
Paspalum setaceum Michx. (slender paspalum); P; G; FAC; BHBCHA, DAOF; OK-500
**Poa annua* L. (annual bluegrass); A; G; FACU; DAOF; OK-510
**Poa pratensis* L. (Kentucky bluegrass); P; G; FACU; QMQSCCFA; OK-519
**Schedonorus arundinaceus* (Schreb.) Dumort. (tall fescue); P; G; FACU; DAOF; OK-354
Schizachyrium scoparium (Michx.) Nash (little bluestem); P; G; FACU; BHBCHA; OK-301
**Sclerochloa dura* (L.) P. Beauv. (common hardgrass); A; G; none; DAOF; OKW-127
Setaria parviflora (Poir.) Kerguélen (marsh bristlegrass); P; G; FAC; DAOF; OK-360
**Setaria pumila* (Poir.) Roem. & Schult.; yellow foxtail; A; G; FACU; DAOF; OK-342
Sorghastrum nutans (L.) Nash (Indiangrass); P; G; FACU; BHBCHA, DAOF; OK-027
Sphenopholis obtusata (Michx.) Scribn. (prairie wedgescale); P; G; FAC; BHBCHA; OKW-054
Sporobolus compositus (Poir.) Merr. var. *drummondii* (Trin.) Kartesz & Gandhi (Drummond's dropseed); P; G; none; DAOF; OK-558
Sporobolus cryptandrus (Torr.) A. Gray (sand dropseed); P; G; FACU; DAOF; OKW-230
Sporobolus vaginiflorus (Torr. ex A. Gray) Alph. Wood var. *ozarkanus* (Fernald) Shinners (Ozark dropseed); A; G; none; DAOF; OK-437
Steinchisma hians (Elliott) Nash (gaping grass); P; G; FACW; HWV; OK-029
Tridens flavus (L.) Hitchc. (purpletop tridens); P; G; UPL; BHBCHA, DAOF; OK-268
Tridens strictus (Nutt.) Nash (longspike tridens); P; G; UPL; DAOF; OK-026
Tripsacum dactyloides (L.) L. (eastern gamagrass); P; G; FAC; DAOF; OKW-212
**Triticum aestivum* L. (common wheat); A; G; none; DAOF; OK-511
Vulpia elliotea (Raf.) Fernald (squirreltail fescue); A; G; none; BHBCHA; OKW-062
**Zea mays* L. (corn); A; G; none; DAOF; OKW-236

Polygalaceae
Polygala incarnata L. (procession flower); A; F; FAC; BHBCHA; OK-112
Polygala verticillata L. (whorled milkwort); A; F; FACU; DAOF; OK-096

Polygonaceae
Eriogonum longifolium Nutt. (longleaf buckwheat); P; F; none; BHBCHA; OKW-174
Fallopia convolvulus (L.) Á. Löve (black bindweed); A; F; FACU; QSQMCCWA; OKW-202
Persicaria hydropiperoides (Michx.) Small (swamp smartweed); A; F; OBL; HWV; OK-228
Persicaria lapathifolia (L.) Gray (curlytop knotweed); A; F; OBL; HWV; OK-048
Persicaria pensylvanica (L.) M. Gómez (Pennsylvania smartweed); A; F; FACW; HWV; OKW-038
Persicaria punctata (Elliott) Small (dotted smartweed); A; F; none; HWV; OK-049
Persicaria virginiana (L.) Gaertn. (jumpseed); P; F; FAC; URCLFPFAFA; OKW-047
Polygonum ramosissimum Michx. (bushy knotweed); A; F; FACW; DAOF; OK-425
Rumex altissimus Alph. Wood (pale dock); P; F; FAC; HWV; OK-382
**Rumex crispus* L. (curly dock); P; F; FAC; BHBCHA, HWV; OK-180
Rumex hastatulus Baldwin (heartwing sorrel); P; F; FAC; DAOF; OK-285

Pontederiaceae
Heteranthera limosa (Sw.) Willd. (blue mudplantain); A; F; OBL; HWV; OKW-023

Portulacaceae
Portulaca oleracea L. (little hogweed); A; F; FAC; HWV; OKW-045
Portulaca pilosa L. (kiss me quick); A; F; FACU; DAOF; OK-245

Potamogetonaceae
Potamogeton foliosus Raf. (leafy pondweed); P; F; OBL; HWV; OK-385
Potamogeton nodosus Poir. (longleaf pondweed); P; F; OBL; HWV; OK-046
Zannichellia palustris L. (horned pondweed); P; F; OBL; HWV; OK-170

Primulaceae
†*Lysimachia quadriflora* Sims (fourflower yellow loosestrife); P; F; FACW; SEEP; OK-089; S1G5?
Primula meadia (L.) A.R. Mast & Reveal (pride of Ohio); P; F; FAC; BHBCHA; OKW-076
Samolus valerandi L. (seaside brookweed); P; F; none; HWV, SEEP; OK-064

Pteridaceae
Pellaea atropurpurea (L.) Link (purple cliffbrake); P; F; none; URCLFPFAFA; OKW-025

Ranunculaceae
Anemone berlandieri Pritz. (ten-petal windflower); P; F; none; MRCMHA; OK-544
Clematis pitcheri Torr. & A. Gray (bluebill); P; F; FACU; URCLFPFAFA; OKW-002
Delphinium carolinianum Walter ssp. *virescens* (Nutt.) R.E. Brooks (Carolina larkspur); P; F; none; DAOF; OK-179
Ranunculus abortivus L. (littleleaf buttercup); P; F; FAC; AMAFSA; OK-291
Ranunculus micranthus Nutt. (rock buttercup); P; F; FACU; HWV; OK-494
**Ranunculus sardous* Crantz (hairy buttercup); A; F; FAC; HWV; OK-379
Ranunculus sceleratus L. (cursed buttercup); A; F; OBL; URCLFPFAFA; OKW-095

Rhamnaceae
Berchemia scandens (Hill) K. Koch (Alabama supplejack); P; V; FAC; QMQSCCFA; OK-165
Rhamnus caroliniana Walter (Carolina buckthorn); P; T; FACU; QMQSCCFA; OK-126

Rosaceae
Crataegus collina Chapm. (hillside hawthorn); P; T; none; QMQSCCFA; OK-509
Crataegus mollis (Torr. & A. Gray) Scheele (Arnold hawthorn); P; T; FAC; BHBCHA; OKW-107
Crataegus viridis L. (green hawthorn); P; T; FAC; QMQSCCFA; OK-402
Fragaria virginiana Duchesne ssp. *grayana* (Vilm. ex J. Gay) Staudt (Virginia strawberry); P; F; FACU; URCLFPFAFA; OKW-148
Geum canadense Jacq. (white avens); P; F; FAC; QMQSCCFA; OK-186
†*Poteridium annuum* (Nutt.) Spach (prairie burnet); A; F; none; BHBCHA, MRCMHA; OK-538; S1G4
Prunus angustifolia Marshall (Chickasaw plum); P; S; none; DAOF; OK-114
Prunus mexicana S. Watson (Mexican plum); P; T; none; URCLFPFAFA; OK-275
Rosa foliolosa Nutt. ex Torr. & A. Gray (white prairie rose); P; F; none; DAOF; OK-093
Rosa setigera Michx. (climbing rose); P; S; FACU; URCLFPFAFA, QMQSCCFA; OK-103
Rubus flagellaris Willd. (northern dewberry); P; S; UPL; BHBCHA, DAOF; OK-534
Rubus pensilvanicus Poir. (Oklahoma blackberry); P; S; FAC; BHBCHA; OK-106

Rubiaceae
Cephalanthus occidentalis L. (common buttonbush); P; S; OBL; HWV, SEEP; OK-220
**Cruciata pedemontana* (Bellardi) Ehrend. (piedmont bedstraw); A; F; none; DAOF; OK-189
Diodella teres (Walter) Small (poor joe); A; F; FACU; BHBCHA; OK-560
Galium aparine L. (catchweed bedstraw); A; F; FACU; DAOF; OK-195
Galium circaezans Michx. (licorice bedstraw); P; F; FACU; QMQSCCFA; OK-105
Galium obtusum Bigelow (bluntleaf bedstraw); P; F; FACW; SEEP; OK-203
Galium virgatum Nutt. (southwestern bedstraw); A; F; none; MRCMHA; OK-205
Houstonia pusilla Schoepf (tiny bluet); A; F; UPL; DAOF; OK-282
**Sherardia arvensis* L. (blue fieldmadder); A; F; none; DAOF; OK-529
Stenaria nigricans (Lam.) Terrell var. *nigricans* (Lam.) Terrell (diamond-flowers); P; F; none; BHBCHA; OK-324

Rutaceae
Ptelea trifoliata L. (common hoptree); P; T; FAC; BHBCHA; OKW-143
Zanthoxylum americanum Mill. (prickly ash); P; T; UPL; QMQSCCFA; OKW-155
Zanthoxylum clava-herculis L. (Hercules' club); P; T; FACU; QMQSCCFA; OK-349

Salicaceae
Populus deltoides W. Bartram ex Marshall (cottonwood); P; T; FAC; URCLFPFAFA; OK-526
Salix nigra Marshall (black willow); P; T; FACW; HWV; OK-530

Santalaceae
Phoradendron serotinum (Raf.) M.C. Johnst. ssp. *tomentosum* (DC.) Kuijt (Christmas mistletoe); P; F; none; URCLFPFAFA; OK-278

Sapindaceae
Acer negundo L. (boxelder); P; T; FAC; URCLFPFAFA; OK-263
Sapindus saponaria L. var. *drummondii* (Hook. & Arn.) L.D. Benson (western soapberry); P; T; FACU; QMQSCCFA; OK-199

Sapotaceae
Sideroxylon lanuginosum Michx. (gum bully); P; T; FACU; QMQSCCFA; OK-107

Scrophulariaceae
**Verbascum thapsus* L. (common mullein); B; F; UPL; DAOF; OK-113

Smilacaceae
Smilax bona-nox L. (saw greenbrier); P; V; FACU; QMQSCCFA; OKW-058
Smilax rotundifolia L. (roundleaf greenbrier); P; V; FAC; QMQSCCFA; OK-198
Smilax tamnoides L. (bristly greenbrier); P; V; FAC; QMQSCCFA; OK-118

Solanaceae
**Datura stramonium* L. (jimsonweed); A; F; none; AMAFSA; OK-489
**Petunia axillaris* (Lam.) Britton, Sterns & Poggenb. (large white petunia); A; F; none; DAOF; OKW-102
Physalis angulata L. (cutleaf groundcherry); A; F; FAC; URCLFPFAFA; OK-448
Physalis heterophylla Nees (clammy groundcherry); P; F; none; QMQSCCFA; OK-473

Physalis longifolia Nutt. var. *longifolia* (longleaf groundcherry); P; F; none; URCLFPFAFA; OK-041
Physalis longifolia Nutt. var. *subglabrata* (Mack. & Bush) Cronquist (longleaf groundcherry); P; F; none; URCLFPFAFA; OK-448
Physalis mollis Nutt. (field groundcherry); P; F; none; DAOF; OKW-015
Physalis pubescens L. (husk tomato); A; F; FACU; URCLFPFAFA; OK-040
Solanum carolinense L. (Carolina horsenettle); P; F; UPL; DAOF; OK-236
Solanum dimidiatum Raf. (western horsenettle); P; F; none; DAOF; OK-372
Solanum rostratum Dunal (buffalobur nightshade); A; F; none; DAOF; OK-318
Solanum ptychanthum Dunal (West Indian nightshade); A; F; FACU; URCLFPFAFA; OKW-021

Typhaceae
Typha domingensis Pers. (southern cattail); P; F; OBL; HWV, SEEP; OK-090

Ulmaceae
Ulmus alata Michx. (winged elm); P; T; FACU; QMQSCCFA; OK-488
Ulmus americana L. (American elm); P; T; FAC; QMQSCCFA; OKW-182
Ulmus rubra Muhl. (slippery elm); P; T; FACU; URCLFPFAFA; OK-333

Urticaceae
Boehmeria cylindrica (L.) Sw. (smallspike false nettle); P; F; FACW; HWV, SEEP; OK-034
Parietaria pensylvanica Muhl. ex Willd. (Pennsylvania pellitory); A; F; FAC; URCLFPFAFA; OK-196
Pilea pumila (L.) A. Gray (Canadian clearweed); A; F; FAC; AMAFSA, URCLFPFAFA; OK-336
†*Urtica chamaedryoides* Pursh (slim stingingnettle); A; F; FACU; URCLFPFAFA; OKW-091; S3G4G5

Valerianaceae
Valerianella amarella (Lindh. ex Engelm.) Krok (hairy cornsalad); A; F; FACU; BHBCHA; OKW-122
Valerianella radiata (L.) Dufr. (beaked cornsalad); A; F; FACW; BHBCHA; OKW-124

Verbenaceae
Glandularia bipinnatifida (Nutt.) Nutt. (Dakota mock vervain); A; F; none; BHBCHA; OK-177
Glandularia pumila (Rydb.) Umber (pink mock vervain); A; F; none; BHBCHA; OKW-083
**Lantana camara* L. (lantana); P; S; FACU; BHBCHA; OKW-041
Phyla lanceolata (Michx.) Greene; lanceleaf fogfruit; P; F; FACW; HWV, SEEP; OK-071
Verbena bracteata Cav. ex Lag. & Rodr. (bigbract verbena); A; F; FACU; DAOF; OKW-011
Verbena halei Small (slender verbena); P; F; none; BHBCHA; OK-243
Verbena urticifolia L. (white vervain); P; F; FAC; URCLFPFAFA; OK-016

Violaceae
Hybanthus verticillatus (Ortega) Baill. (babyslippers); P; F; none; MRCMHA; OK-476
Viola bicolor Pursh (Johnny jump-up); A; F; FAC; DAOF; OK-464
Viola sororia Willd. var. *missouriensis* (Greene) L.E. McKinney (Missouri violet); P; F; FACW; URCLFPFAFA; OK-266

Vitaceae
Ampelopsis cordata Michx. (heartleaf peppervine); P; V; FAC; QMQSCCFA; OK-119
Cissus trifoliata (L.) L. (sorrelvine); P; V; FACU; URCLFPFAFA; OKW-028
Parthenocissus quinquefolia (L.) Planch. (Virginia creeper); P; V; FACU; QMQSCCFA; OK-117

Vitis cinerea (Engelm.) Engelm. ex Millard (graybark grape); P; V; FAC; URCLFPFAFA; OK-527
Vitis vulpina L. (frost grape); P; V; FAC; URCLFPFAFA; OKW-166

Woodsiaceae
Woodsia obtusa (Spreng.) Torr. (bluntlobe cliff fern); P; F; none; QMQSCCFA; OK-127

FIRST OBSERVATIONS OF *PALAFOXIA CALLOSA* IN WASHITA COUNTY, OKLAHOMA

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ABSTRACT

Palafoxia callosa (Nutt.) Torr. & A. Gray is a critically imperiled plant that has an extremely restricted distribution in Oklahoma with all previous observations recorded from Caddo and Pontotoc Counties. Here we report the first observations of *P. callosa* in Washita County, Oklahoma. Considering the restricted distribution and limited information available on *P. callosa* in Oklahoma, additional surveys are needed to assess the population status and current threats to the conservation of this species.

Keywords: Asteraceae, **Palafoxia***, biogeography, rare species*

INTRODUCTION

Palafoxia callosa (Nutt.) Torr. & A. Gray was observed on five occasions at the same research site in Washita County, Oklahoma. The authors observed a population of individuals at the Klemme Range Research Station in Washita County, Oklahoma in September 2019 (Figure 1). Additional observations occurred in September 2016, September 2017, and July 2018 at the same site (Figure 2). A voucher specimen was collected in August 2015. These observations were the first on record for this species in Washita County, Oklahoma (Hoagland et al. 2020).

MATERIALS AND METHODS

The observations were made during routine field sampling work at a terrestrial National Ecological Observatory Network (NEON) site at the Klemme Range Research Station (35.41059, -99.05879) near the town of Burns Flat in Washita County, Oklahoma (NEON 2020b).

The voucher specimen was collected as part of standardized sampling efforts to support identification of unknown species. The voucher specimen is currently being stored in the herbarium at NEON's Southern Plains domain support facility in Denton, Texas. The conservation status of *P. callosa* was not known at the time of collection.

DISCUSSION

Palafoxia callosa is a member of the Asteraceae family. The species is an annual herb with glandular stems that reach 20-60 cm tall at maturity. The inflorescence is discoid, with pink disk flowers. Anthers are maroon to reddish purple. Leaves are linear, measuring 20-70 x 1 mm, with glandular-based hairs. The phyllaries are 3-5 x 1.4 mm. The fruit is a pappus-bearing achene (Diggs Jr. et al. 1999).

Palafoxia callosa is very similar to *Palafoxia rosea* and the two species may be confused where their distributions overlap. The main

distinctions are the width and length of the phyllaries, and the shape and length of the pappus scales. The phyllaries of *P. rosea* are longer and wider than those of *P. callosa*, and generally measure 1-2.5 x 5-10 mm long (Figure 3). The pappus scales of *P. rosea* are usually longer (1.5-8 mm long) than those of *P. callosa* (0.3-2 mm long) (Figure 4) (Strother 2020).

Palafoxia callosa has been documented in the south-central United States, occurring in Missouri, Arkansas, Louisiana, Mississippi, Oklahoma, and Texas. This species has also been documented in the state of Coahuila, Mexico (USDA 2020).

In Oklahoma, there are only two previous records of this species. There is one specimen recorded in Caddo County from 1985 and one specimen recorded in Pontotoc County in 1951 (Hoagland et al. 2020). According to NatureServe (2020) the species' global status is G4 (Apparently Secure), but for Oklahoma it has been listed as SH (Possibly Extirpated).

In September of 2020, the Oklahoma Natural Heritage Program (ONHP) confirmed that the heritage status rank for *P. callosa* was updated to S1 (critically imperiled), but the Oklahoma Natural Heritage Tracking List has not been updated to reflect this change. Additionally, ONHP stated that even though the *Flora of North America* does not include Oklahoma in the distribution description of *P. callosa*, the ONHP has decided to include this species in the next revision of *Flora of Oklahoma* (Amy Buthod, Oklahoma Biological Survey/Oklahoma Natural Heritage Inventory/Bebb Herbarium, personal correspondence 2020).

Habitat types for *P. callosa* include gravelly stream edges, rocky limestone glades and prairies (NPIN 2013). The habitat for *P. callosa* at the Klemme Range Research Station consists of short and mixed grass prairie, gravelly stream edges, and rocky outcrops (Figure 5). The site is dominated by soils in the Cordell series (USDA 2019). The Cordell soil series is characterized by gravelly, calcareous loamy soils. The soil is typically shallow and underlain by reddish sandstone and siltstone that supports vegetation adapted to arid, well-drained conditions (USDA 2019). At the Klemme Range Research Station, the associated species include *Sporobolus compositus* (Poir.) Merr., *Thelesperma filifolium* (Hook.) A. Gray, *Ratibida columnifera* (Nutt.) Woot. & Standl., *Bouteloua curtipendula* (Michx.) Torr., and *Ophioglossum engelmannii* Prantl (NEON 2020a). The population size of this taxon is estimated to be several hundred individuals at Klemme Range Research Station.

Figure 1 *Palafoxia callosa* observed in situ in September of 2019 in Washita County, Oklahoma

Figure 2 *Palafoxia callosa* observed in situ in September 2017 in Washita County, Oklahoma

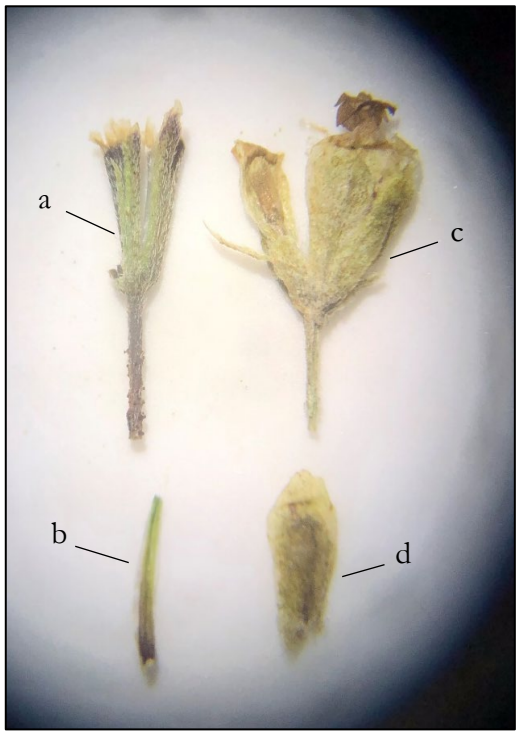

Figure 3 *Palafoxia callosa* a) phyllaries; b) a single phyllary; *Palafoxia rosea* c) phyllaries; d) a single phyllary. Voucher specimens collected in Washita County, Oklahoma in summer of 2015.

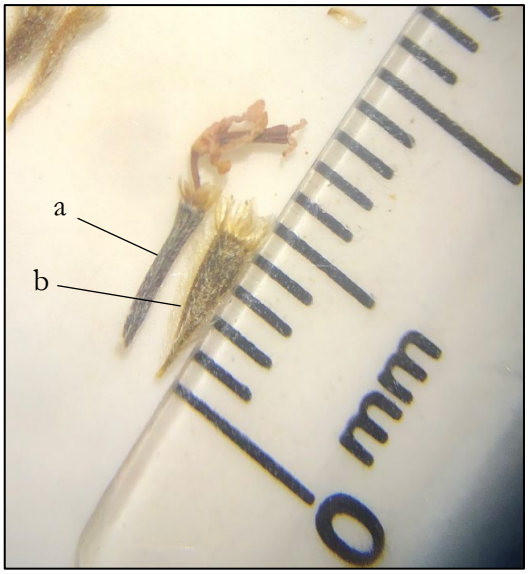

Figure 4 a) *Palafoxia callosa* achene with pappus and b) *Palafoxia rosea* achene with pappus. Voucher specimens collected in Washita County, Oklahoma in summer of 2015.

Figure 5 An example of *Palafoxia callosa* habitat during October of 2018 at Klemme Range Research Station

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SOME COMMON *AMANITA* SPECIES OF OKLAHOMA

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ABSTRACT

Brief descriptions and photos are presented for twenty species of the mushroom genus *Amanita* that are common to Oklahoma. The descriptions and illustrations introduce mushroom morphology and terminology for Amanitas that are important for their identification. Short diagnoses are also presented for each of the seven sections of *Amanita*. The species are arranged according to their placement in each section. One species, *A. persicina*, has not yet been reported for Oklahoma but we include it with the speculation that it is present in the pine forests of eastern Oklahoma.

Key words: Agaricomycetes, Amanitaceae, mushrooms, biodiversity

INTRODUCTION

Amanita is a charismatic genus because of its reputation for having some of the deadliest poisonous species, because of the lore associated with several species, and because of their artistic beauty. Amanitas rank among the most photographed or painted of all wild mushrooms. Illustrations of Amanitas are frequently featured on tea towels, coffee cups and many other kitchen items.

Amanita is a fairly large genus of gilled mushrooms, estimated to contain about 1,100 species worldwide. Nearly all species form ectomycorrhizae with forest trees such as oaks, hickories, beeches, and many genera of conifers. This association is beneficial to both the host trees and the fungus—the plant trades photosynthates in exchange for fungus-acquired nutrients from the soil. Amanitas will therefore most often be encountered in forested areas as long as the mycorrhizal tree species are present. The geographical "hot spot" that has the greatest diversity of Amanitas in North America, and perhaps the entire world, is the Southeastern/Gulf Coast regions of the United States. We cannot estimate for sure how many species occur in Oklahoma but it could be as many as one hundred.

In this article, we report on and illustrate some of the frequently encountered Amanitas in Oklahoma. By way of brief descriptions and photos, we also introduce the morphological characters that are important in their classification and identification. Brief summaries of the sections of *Amanita* are provided in order to aid the collector in providing placement of a species within the genus if it cannot be identified to species. We are slightly biased in featuring species that occur in hardwood forests of central Oklahoma because that is where the first author has done most of his collecting. Further exploration of the pine and mixed hardwood-pine forests of

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Oklahoma should yield additional diversity of Amanitas. We do indicate which species are poisonous, but refrain from indicating which species are edible. It is incumbent upon the collector to thoroughly learn the morphological characters of fungi in general in order to correctly identify edible species and eliminate the risk of confusing edible with poisonous ones. Scale line in the photos = 2.5 cm.

DESCRIPTION OF THE GENUS *AMANITA*

Spore print is white, and spores are amyloid or inamyloid; lamellae are free, that is, the lamellae are not attached to the stipe; universal veil is present; presence of a partial veil that leaves a persistent or fugacious annulus, with the exception of section *Vaginatae* that lacks a partial veil. The universal veil is a membranous tissue that encloses the entire mushroom in the button stage (Figure 7). The universal veil can take on two different forms: in one form a membranous volva (sac) remains at the base of the stipe (Figure 7), in the other form, the universal veil leaves fragments in the form of patches, warts or powdery material on the pileus surface, and there may or may not be a few velar patches, warts or ridges on the stipe base (Figure 5).

An important microscopic feature for *Amanita* is the reaction of basidiospores to Melzer's Reagent, an iodine solution (for recipe see Bunyard 2019). This is a test used on many other genera of mushrooms as well. Spores are said to be amyloid if they turn blue-black in the reagent and inamyloid if there is no color reaction. To conduct this test, lamellar sections or spores taken from a spore print are viewed under a microscope to see if there is the color reaction. Determining the amyloid reaction is important for assigning a fungus to a section of *Amanita* and may be necessary for confirming a species identification.

SECTIONS OF *AMANITA* WITH EXAMPLES OF SPECIES

The genus *Amanita* is typically divided into seven sections based on the macroscopic and microscopic features that the species possess.

Section *Amanita*. Species of this section share the following characteristics: stipe that terminates with a bulbous base; small universal velar patches or warts on the pileus and basal bulb and absence of a saccate volva; presence or absence of an annulus that often flares out from the stipe; striations (narrow grooves) at the pileus edge. The pilei often have bright colors such as red, yellow or orange. Microscopically, the spores are inamyloid.

Amanita farinosa Schwein (Figure 1) is one of the smaller *Amanita* species. The pileus has a grayish coloration and a powdery dust-like covering over the entire surface. It lacks a partial veil and a membranous volva. The universal veil material at the stipe base is a grayish, powdery-granular covering. This *Amanita* has only been recorded from southeast Oklahoma in mixed pine-hardwoods.

Figure 1 *Amanita farinosa*

Amanita multisquamosa Peck (Figures 2 and 3) is characterized by the tan to yellowish tan pileus that has numerous whitish velar patches on the surface, and the pileus edge is striate. It lacks a membranous volva; instead, the upper portion of the basal bulb of the stipe has a collar-like rim encircling it. The stipe has a membranous annulus that soon clings to the stipe or disappears. *Amanita multisquamosa* belongs to the "pantheroid" complex of species and all are to be considered poisonous (Bunyard and Justice, 2020).

Figure 2 *Amanita multisquamosa*

Figure 3 *Amanita multisquamosa*

Amanita pubescens Schwein. sensu Coker (Figure 4) is characterized by the pale yellow pileus covered with warty velar patches, the lack of an annulus, and the stipe base which is bulbous to turnip-shaped and which generally lacks any volval material except when young. The stipe is rather short compared to the width of the pileus. It is often found in grassy areas near oak trees in city parks.

Figure 4 *Amanita pubescens*

Amanita persicina (D.T. Jenkins) Tulloss & Geml (Figure 5) is one of the most colorful and recognizable *Amanita* species and has the common name of "Fly Agaric." Most older field guides list the species as *A. muscaria* (L.:Fr.) Lam. and the type variety, var. *muscaria*, is endemic to Europe and Asia. It is also found in Alaska, but not in the continental United States with the possible exception of several occurrences with

Figure 5 *Amanita persicina*

introduced tree species. There are, however, at least two variants of *Amanita muscaria* that have been described from North America: *A. muscaria* subsp. *flavivolvata* Singer, a red-capped subspecies from the western states, and *A. muscaria* var. *guessowii* Veselý, which has yellow to yellow-orange pilei and occurs in the eastern U.S. *Amanita persicina* is the accepted name for the fungus in the complex that is common along East Coast and Gulf Coast regions. The pileus is orange-red to light orange at the center and light orange to yellow on the margin, and has light-colored universal veil patches or warts scattered over the surface. The stipe base is bulbous and lacks a membranous volva but has low rings or ridges of tissue. An annulus is present and is easily torn or collapsed. We include *A. persicina* because we anticipate that it or another variant in the complex does occur in Oklahoma under pines in the eastern part of the state, even though we have yet to confirm its presence. Species in the "muscaria" complex are poisonous.

Section *Caesareae*. Fungi of this section lack velar warts on the pileus so the surface is smooth. The universal veil leaves a persistent membranous, saccate (cup-like) volva at the stipe base. Other features of section *Caesareae* include the lack of a bulbous base, striations at the edge of the pileus, and hollow stipes in mature specimens. Typically, the pilei exhibit bright colors such as red, yellow, orange, or sometimes combinations of those colors. While the lamellae of many species in other sections are typically a white or pallid color, the lamellae in this section are often yellow, or sometimes yellow-orange. Microscopically, the spores are inamyloid. Many species in this section are sold as edible mushrooms at the open markets in Mexico, Europe, Africa, and Asia.

Amanita arkansana Rosen (Figure 6) has a yellow to yellowish orange, smooth pileus that lacks velar patches and is striate at the edge. The lamellae are whitish to pale yellow. The stipe is light yellow and the annulus is flared but soon clings to the stipe. A white saccate volva is present at the stipe base. *Amanita cahokiana* Tulloss & Sanchez-Ramirez nom. prov. is a cryptic species that has a yellower pileus than *arkansana*. Further collecting should reveal if only one or both species occur in Oklahoma.

Figure 6 *Amanita arkansana*

Amanita jacksonii Pomerleau (Figure 7) is one of the more colorful and striking species of *Amanita*. The pileus is bright red to orange-red, lacks velar patches on the surface, and is striate at the edge. The lamellae are light yellow and the stipe is yellow to yellow-orange. The annulus is persistent but often collapses, and a white saccate volva is present at the stipe base. In many of the older field guides this fungus is identified as *A. caesarea*, but that is a European species and does not occur in North America.

Figure 7 *Amanita jacksonii*

Amanita spreta Peck (Figure 8) is a rather large mushroom with a light brown to grayish brown, smooth pileus that is striate at the edge. The lamellae and stipe are white. The partial veil is flaring and the stipe base has a white volva that can vary from saccate to smaller cupulate.

Figure 8 *Amanita spreta*

Section *Vaginatae*. This is the largest section of *Amanita* and contains about 400 species worldwide. The universal veil either leaves a saccate volva at the stipe base or the volva is absent and the veil remnants are patches on the pileus surface. A partial veil is lacking. The spores are inamyloid. Features that *Vaginatae* share with section *Caesareae* include the lack of a bulbous base, striations at the edge of the pileus, and hollow stalks in mature specimens. Species in sect. *Vaginatae* are distinguished from those of sect. *Caesareae* by the lack of bright pileal colors and by the lack of a partial veil.

Amanita fulva (Schaeff.) Fr. (Figure 9 and 10) has a fulvous-colored pileus, often with a low raised umbo, and the pileus edge is striate. The stipe base has a saccate volva but it lacks a partial veil. This is the only confirmed volvate species in sect. *Vaginatae* from Oklahoma although we have encountered considerable undocumented diversity of fungi with a volva in this section.

Figure 9 *Amanita fulva*

Figure 10 *Amanita fulva*

Amanita* cf. *ceciliae (Berk. & Broome) Bas (Figure 11) is a species in section *Vaginatae* that lacks a membranous volva; rather, the universal veil leaves most of the remnants as grayish patches on the pileus surface. The stipe base at most may have a few scattered velar patches and, typical for the section, a partial veil is lacking. The pileus is brownish gray to gray and is distinctly striate to sulcate at the edge. *Amanita ceciliae* is a European name so it is very probable that the fungus illustrated here will eventually be newly described along with several other North American taxa in the complex (Tulloss and Yang, 2020).

Figure 11 *Amanita* cf. *ceciliae*

Section *Amidella*. This section is characterized by two features: pileus surface possessing universal veil patches or floccose remnants, and a well-formed saccate volva, which can vary in shape from nearly globose to elongate and is often large and baggy. The pileus and stipes of species of this section often stain pinkish upon bruising, at least when young and fresh. During maturation, the discoloration becomes brownish red. Microscopically, the spores are amyloid.

Amanita peckiana Kauffman (Figure 12) is distinguished by its rather short stature, whitish basidiomes that discolor pinkish to brownish, thin partial veil that soon disappears, and by the well-developed saccate volva. It is a rarely

Figure 12 *Amanita peckiana*

encountered species but we have several records of it from Oklahoma.

Section *Validae*. This section shares the following set of features: bulbous stipe base, persistent partial veil, and universal veil remnants in the form of warts on the pileus surface. The color of the pilei ranges from white to bright yellow to drab grays and reddish-brown. Some have the odor of cut raw potatoes and a few have fruity odors. Some species develop pinkish or reddish-brown stains when handled or bruised. The spores are amyloid.

Amanita amerirubescens Tulloss nom. prov. (Figure 13) is easily recognized because all parts of the mushrooms stain wine-red to reddish brown. The pileus varies from brown to yellowish brown and is covered with cream to pale yellow velar patches or warts. The lamellae and stipe are white to begin with but quickly discolor wine-red. The stipe base is slightly swollen, often with no trace of the universal veil; an annulus is present but soon clings to the stipe. This species is listed as *A. rubescens* in most field guides, but that is a European species that does not occur in North America. *Amanita amerirubescens* is currently treated as a species complex, meaning that more than one species with similar features are found in this complex. Currently, at least nine taxa are known to occur in this complex based on molecular analyses, but

differentiation based on morphology is often very difficult (Tullos and Yang, 2020).

Figure 13 *Amanita amerirubescens*

Amanita brunnescens G. F. Atkinson (Figure 14) has a brown pileus but sometimes the pigmentation is mainly at the center as is shown in the photo. Velar patches are usually present on the pileus and a partial veil is present on the stipe. The stipe base is bulbous and generally lacks volval remains, but the presence of vertical clefts in the base is a good distinguishing

Figure 14 *Amanita brunnescens*

feature of this species. All parts of the basidiome may stain brown to orange-brown. The odor of raw potatoes is detected when the lamellae are crushed.

Amanita canescens D. T. Jenkins (Figure 15) has a gray to brownish gray pileus surface that is covered with velar warts over much of the surface. The stipe is white but the surface fibrils often discolor dull orange. A membranous annulus is present, whose underside also has an orangish color. A membranous volva is absent, but remnants of the universal veil as irregular patches can be present on top of the swollen base.

Figure 15 *Amanita canescens*

Amanita flavoconia G. F. Atkinson (Figure 16) is a distinctive species and is easily recognized by its yellow to yellow-orange pileus with scattered yellowish universal veil remnants on the surface. The annulus is flared at first but then may collapse to the stipe. A saccate volva is not present, rather there are scattered yellow universal veil remnants atop the swollen base and sometimes on the lower portion of the stipe. The yellow remnants can also remain in the soil as the fungus is dug up.

Figure 16 *Amanita flavoconia*

Amanita flavorubens (Berk & Mont.) Sacc. (Figure 17) has a similar appearance to *A. amerirubescens* but it has more pronounced yellow coloration to the pileus, velar patches, and stipe. The stipe has a membranous annulus and the base has no or only slight remnants of the universal veil. The exterior of the stipe and to some extent the gills of this *Amanita* also become reddish-brown when bruised or in old age, but their degree of staining is not as dramatic as that observed in specimens of *A. amerirubescens*.

Figure 17 *Amanita flavorubens*

Section *Lepidella*. Section *Lepidella* is characterized by the following set of features: stipe bases that have a pronounced bulb that often tapers downward (radicating), universal veil remnants as warts on the pileus surface and often on the stipe base, and lack of a membranous volva. The pileus and stipe surfaces of some species have a powdery coating that easily comes off upon touching. Pilei also frequently have an appendiculate margin where small pieces of partial veil material hang down from the pileus edge. Microscopically, the spores are amyloid. Some species have interesting odors which have been described as being reminiscent of "old ham" or "old tennis shoes" or chlorine-like. Many species in this section are very large with the pilei often attaining a diameter of 12 inches or larger.

Amanita abrupta Peck (Figure 18) is an all-white mushroom with a pileus that has subconical velar warts covering most of the surface. Also distinctive is the turnip-shaped stipe base that is flattened on top and which

Figure 18 *Amanita abrupta*

lacks a membranous volva. At most, the universal veil leaves a few scattered floccose warts on top of the swollen base.

Amanita longipes Bas ex Tulloss & D.T. Jenkins (Figure 19) is another all-white fungus that has a pulverulent-floccose coating on the surfaces of the pileus and stipe, and lacks the pointed warts on the pileus. The carrot- or turnip-shaped stipe base is also characteristic. The partial veil is

Figure 19 *Amanita longipes*

very fleeting and is only seen on young expanding mushrooms, leaving almost no trace on the stipe. A membranous volva is lacking. This fungus is found in hardwood forests and is associated with oaks, compared to the much larger *A. polypyramis* which is a pine associate.

Amanita polypyramis (Berk. & Curt.) Sacc. (Figure 20) is one of the largest *Amanita* species that will be encountered. It is so large that it can be spotted in the forest while driving on a highway! It occurs under pines so it is only found in eastern Oklahoma. In addition to its large size and bulbous base, it is entirely white and the pileus and stipe are covered with a white pulverulent-floccose surface layer that is the remains of the universal veil. This coating easily comes off when touched. The partial veil mostly remains attached to the pileus edge as the pileus expands and then easily falls off as can be seen in the photo. *Amanita polypyramis* has a chlorine-like odor when fresh.

Figure 20 *Amanita polypyramis*

Amanita thiersii Bas (Figure 21) is one of only a few Amanitas that occur independently of forest trees and is often described as being a "free-living" *Amanita*. It is a fairly large mushroom and is common on lawns in Oklahoma in the late summer and early fall. The pileus and stipe are white and have a floccose-pulverulent coating on their surfaces. This coating is very delicate and will easily sluff off and coat a person's fingers when the stipe is touched or handled. The partial veil may remain attached to the stipe. The lamellae are initially a light cream color, but often become creamy yellow as they mature. Another large lawn mushroom is *Chlorophyllum molybdites*, but it has green lamellae and brownish scales on the pileus.

Figure 21 *Amanita thiersii*

Section *Phalloidae*. Species in this section typically have the following features: pilei that are white or if pigmented, have subdued tones of brown or greenish-yellow and lack any striations or radial lines on the pileus edge; stipes with partial veils that are attached near the apex; and bulbous bases that are encased in a membranous volva. Microscopically the spores are amyloid. All members of this section are likely to be deadly poisonous and should not be eaten.

Amanita bisporigera G. F. Atkinson (Figure 22) is known as the "Destroying Angel" because of its toxicity. It is easily recognized by its all-white coloration, smooth pileus that is typically not striate at the edge, bulbous base encased by a saccate volva, and flaring annulus near the stipe apex. All parts of the mushroom turn yellow where a solution of KOH (3%-10%) is applied. It is somewhat common during the summer months and found associated with oaks and other hardwood trees. The

combination of these features should be a warning sign that it is potentially deadly poisonous if eaten. According to Bunyard and Justice (2020) there is a complex of five or six species that share similar morphology to *A. bisporigera*. Older field guides will have this species listed as *A. virosa* which is a European taxon that does not occur in North America.

Figure 22 *Amanita bisporigera*

FURTHER READING

A field guide on *Amanita* was recently published by Bunyard and Justice (2020) that is an excellent source of information on Amanitas for North America. Dr. Rodham Tulloss, who is perhaps the preeminent scholar on Amanitas in the United States, maintains an excellent website that includes much technical information on the genus (Tulloss and Yang 2020). Michael Kuo also has an excellent website for mushrooms in general including Amanitas (http://www.mushroomexpert.com). To learn more about mushroom morphology and taxonomy in general, most all mushroom field guides provide excellent information for the beginner.

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FALL AVAILABLE TROPICAL MILKWEED (*ASCLEPIAS CURASSAVICA* L.) MAY BE A POPULATION SINK FOR THE MONARCH BUTTERFLY

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ABSTRACT

Native plants provide the best habitat for pollinators, but non-native plants can supply resources to native pollinators. The non-native tropical milkweed (bloodflower or scarlet milkweed), *Asclepias curassavica* L., is a larval food source for the native monarch butterfly (*Danaus plexippus*). *Asclepias curassavica* has been widely planted in the southern U.S. where it blooms until late fall, retains healthy vegetation until frost, and does not die back until a hard freeze. In contrast, native *Asclepias* species senesce and are usually not suitable for monarch larvae consumption in the fall. The late availability of the non-native milkweed may trigger monarchs, normally migrating to Mexico, to break reproductive diapause and lay eggs on their host plant. To determine if non-native *A. curassavica* was more likely than native *Asclepias* species to attract egg-laying monarchs, we grew native *Asclepias viridis* Walter and *Asclepias speciosa* Torr. along with *A. curassavica* in Oklahoma and recorded the number of monarch eggs and caterpillars on each plant. From August 2019 until the first freeze, we observed 145 eggs and 39 caterpillars on 40 of 48 *A. curassavica* plants and one egg on one of 19 native *Asclepias* plants. First freeze occurred on 12 October. A majority of eggs were laid after 12 September resulting in most eggs having insufficient time to mature. This freeze date was nearly 3 weeks earlier than the average for this area. Our evidence suggests that the monarchs are differentially reacting to the availability of non-native and native *Asclepias* during late summer and fall.

INTRODUCTION

Pollinator gardens have become a popular landscaping trend in recent years (Majewska and Altizer 2018). With the continued loss and fragmentation of native habitats, millions of private citizens have decided to take conservation action at their own home, school, and businesses (Phillips 2019). Using native plants in a garden or planned landscape provides the best habitat for native pollinators (Burghardt et al. 2009). However, the availability of native species for landscaping lags behind non-native cultivars. Yet, there are a variety of non-native species that can provide food, both for adults and larvae, for our native pollinators. The advantage of using some non-natives in a pollinator garden is that they are easy to grow and widely available.

One of the most popular species to attract to pollinator gardens in North

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America is the monarch butterfly (*Danaus plexippus*). The most common conservation action associated with the monarch butterfly is to plant the larval host plant – milkweed (*Asclepias*). The easily cultivated and widely available tropical milkweed (also known as bloodflower and scarlet milkweed), *Asclepias curassavica* L., is a popular species grown in Oklahoma and other southern states (Figure 1). This species is also the most popular species for rearing monarchs indoors, although this practice has been called into question because of potentially negative effects captive rearing has on the migratory behavior of the species (Tenger-Trolander et al. 2019). *Asclepias curassavica* is a non-native species that, when grown in Oklahoma, blooms late into the fall, retains healthy vegetation until frost, and does not fully die back until the first hard freeze. In contrast, by late summer, vegetation of native *Asclepias* species is often old, tough, or senesced and generally not suitable as a food source for monarch larvae (Zalucki and Kitching 1982, Baum and Sharber 2012).

Figure 1 Tropical milkweed, *Asclepias curassavica*, a non-native species, is a popular plant to grow in Oklahoma and other southern states because it is easily cultivated, with a long blooming season of strikingly bold flowers. Not only is it a showy addition to gardens, it also is a host plant for the monarch butterfly caterpillar. However, our research suggests that late summer and fall availability of *A. curassavica* may be detrimental to migrating monarch butterflies.

The charismatic monarch butterfly has caught the attention of the public and conservationists, who have made it a symbol of nature, environmental health, spiritual renewal, and safe passage across borders (Gustafsson et al. 2015). In 2014, the U. S. Fish and Wildlife Service was petitioned by the Center for Biological Diversity to list the monarch butterfly as an Endangered Species (U. S. Fish and Wildlife Service 2020). With the potential for required conservation activities if listed as endangered, many entities are interested in proactive conservation that will bolster the population without the need for federal regulation. This situation has inspired conservation actions by citizen groups, tribal collaborations, state agencies, and agricultural organizations within Oklahoma (Oklahoma Monarch and Pollinator Collaborative 2016).

Oklahoma lies directly in the path of monarch butterfly migration from Mexico to the upper Midwest, making our location critical for monarch conservation both during the spring and fall migrations. The annual monarch migration takes four to five generations to complete the entire migratory cycle. Monarchs that populate central and eastern North America in the summer will overwinter as adults in mountainous habitat in Mexico. In the early spring, the overwintering adults become reproductively active and begin to migrate north. Depending on the weather conditions, adults usually lay eggs on host plants in Texas and Oklahoma during the spring to produce the first generation of the year. After those eggs hatch, develop through the caterpillar instars, pupate in chrysalises, and eclose as adults, the first-generation butterflies will continue to travel north and have two to three more generations, a majority of them in the upper Midwest. In the late summer, adult butterflies will begin the return journey south. Some will be reproductively active and will lay eggs on available host plants in Oklahoma during August through October for the 4th or 5th generation of monarchs for the year (Baum and Sharber 2012, Flockhart et al. 2013, 2017).

Monarchs have been shown to enter reproductive diapause during the fall migration based on three environmental cues: photoperiod, temperature, and availability of milkweed host plants (Zalucki and Kitching 1982, Goehring and Oberhauser 2002, Baum and Sharber 2012). If one of these cues changes, such as warm fall temperatures or available milkweed, monarchs will break diapause and reproduce during the typical fall migratory time (Goehring and Oberhauser 2002, Malcolm 2018). This has implications for the persistence of the migratory behavior under climate change scenarios (Tenger-Trolander et al. 2019). While much of the native milkweed has senesced in the late summer and early fall, *A. curassavica* is available with attractive vegetation well into fall until the first hard freeze. Majewska and Altizer (2019) demonstrated that captive-reared monarch larvae fed a diet of *A. curassavica* under fall-like conditions are more likely to be reproductively active than those reared on native species. Additionally they demonstrated that female monarchs caught during fall migration showed greater egg development when exposed to *A. curassavica* (Majewska and Altizer 2019). Depending on the timing, additional reproduction during what is typically considered the fall migration period could positively or negatively affect the monarch population. Reproduction in late summer may add a generation to the annual cycle, allowing younger individuals to complete the now-shorter migration to Mexico. However, laying eggs in late fall may be a reproductive sink if larvae do not have time to mature to the adult butterfly stage before freezing

temperatures and continue the migration south.

We were interested in investigating what effect the availability of *Asclepias*, both native and non-native species, had on the reproductive behavior of monarchs moving across Oklahoma in late summer. To determine if the non-native *A. curassavica* was more likely than native *Asclepias* species to attract egg-laying monarch butterflies late into the growing season and during the migratory period, we grew two native *Asclepias* species and *A. curassavica* outdoors in central Oklahoma and made observations of monarch eggs and caterpillars during the late summer and early fall of 2019.

METHODS

We cultivated two milkweed species native to Oklahoma, *Asclepias viridis* Walter and *A. speciosa* Torr. and the non-native *A. curassavica* in outdoor raised beds at the Aquatic Research Facility on the campus of the University of Oklahoma, Norman, OK (35.1833 N, -97.4485 W). This research site, on the edge of an urban area, has natural habitat within 0.25 km of our raised beds. The environment surrounding the beds is mowed lawn and artificial ponds used for aquatic research. Within a circular fabric raised bed (1.25 m diameter x 0.3 m tall, Smart Pot® www.smartpots.com), we planted eight greenhouse-raised plants of a single species of milkweed surrounding native nectar plants, including *Symphyotrichum novae-angliae* (L.) G. L. Nesom and *Vernonia fasciculata* Michx. with *Verbesina encelioides* (Car.) Benth. & Hook. f. ex A. Gray dominating. We planted six beds of each milkweed species, totaling 48 individuals of each species (Figure 2). Beds were arranged in a 3 x 6 grid and *Asclepias* species were randomly assigned beds. Beds were watered equally as needed during the growing season. Walkways between beds were covered with landscape weed barrier fabric. Non-target species were removed by hand from within the beds and cut using a string trimmer outside of the beds. Nectar plants were pruned regularly to ensure the *Asclepias* had ample room to grow (Figure 3). Following the methods of Zalucki and Kitching (1982) we inspected all milkweed foliage, including the underside of the leaves, for monarch egg and caterpillar presence twice a week (Figures 4 and 5). Based on monarch sightings in Oklahoma reported to Journey North's migratory database (https://maps.journeynorth.org/maps), our observations began 12 August when monarchs were beginning to be reported in northern Oklahoma. We recorded the number of eggs and caterpillars found on each plant and noted caterpillar instar, 1-5 (Oberhauser and Kuda 1997).

RESULTS

Many plants of the two native *Asclepias* species failed to thrive, with only two out 48 *A. viridis* plants and 17 out of 48 *A. speciosa* plants having live aboveground vegetation in the late summer. However, all native plants that survived the summer had senesced by late August. All 48 *A. curassavica* survived through the summer and fall until our first freeze.

From 12 August to 15 October, we observed 145 eggs and 39 caterpillars on 40 of the 48 *A. curassavica* plants and 1 egg on an *A. viridis* plant. Because of the loss of 77 of the 96 native *Asclepias* plants, we were not able to conduct a statistical analysis to compare the native versus non-native milkweed usage by monarchs. Yet, despite the unequal and small sample size, our data indicate that monarchs were highly attracted to the *A. curassavica* vegetation for egg laying during fall migration.

The majority of the eggs were laid between 10 September and 26 September (Figure 6). During this interval, 101 eggs and 39 caterpillars were recorded. The final eggs we found were on 1 October. The total

number of eggs observed during the duration of the study was 145. Additionally, during the entire duration of the study, we found no caterpillars older than 3rd instar and no chrysalises. On 12 October, nighttime temperature dropped below freezing, killing all aboveground vegetation of *A. curassavica*. We continued to inspect the area for caterpillars and eggs until 15 October. In ideal temperature conditions monarchs need 24 days to mature from egg to adult (Zalucki 1982). Development of larvae is generally slower during the cooler fall conditions. In 2019, our first freeze occurred on 12 October and more than half of the eggs were laid after 12 September. Consequently, the majority of monarch eggs had insufficient time to mature before the first freeze.

Figure 2 Circular fabric raised beds (1.25 m diameter x 0.3 m tall, Smart Pot® www.smartpots.com) were filled with commercial topsoil and arranged in a 3 x 6 grid with landscape weed barrier fabric between beds. The research site, on the edge of an urban area, has natural habitat within 0.25 km of our raised beds.

Figure 3 Raised bed of *A. curassavica* and nectar plants in bloom on 27 September 2019

Figure 4 Monarch butterfly egg, circled in red, on the underside of an *A. curassavica* leaf (yellow aphids can also be seen to the upper left)

Figure 5 Third instar monarch caterpillar on the lowest leaf of one of 48 *A. curassavica* plants in the research beds

DISCUSSION

As an easy-to-cultivate plant with a long blooming season of strikingly bold flowers, gardeners have embraced *A. curassavica* as a beautiful addition to their garden that also has conservation value. Yet, the use of *A. curassavica* as a species for monarch conservation has been under scrutiny for the past several years by conservationists (Monarch Joint Venture n.d., Wheeler 2018). Monarch researchers have shown *A. curassavica* to be a problematic species for monarchs because of the increased likelihood of this species to harbor the deadly protozoan *Ophryocystis elektroscirrha* (*OE*) from season to season (Satterfield et al. 2015). This organism is a natural parasite of the monarch butterfly, but where *Asclepias* does not die back at the end of the growing season *OE* can reach high levels and wipe out local monarch populations. When *Asclepias* is available all year, overwintering and winter reproduction has been documented in Florida, Texas, South Carolina, Louisiana, Georgia, Alabama, Mississippi, and North Carolina (Howard et al. 2010). There is a concern that increased *OE* will eliminate these populations. In Oklahoma, our winter conditions do not currently allow year-round growth of *A. curassavica*, but that is likely to change with global climate change. Areas in Texas, Florida, and along the Gulf Coast are already seeing signs of *A. curassavica* becoming invasive (EDDMapS 2020). Additionally, captive-bred monarchs are more susceptible to diseases, and in particular *OE* can easily spread to natural populations when captives are released for education or entertainment, such as at festivals, weddings, or other celebrations (Journey North 2015).

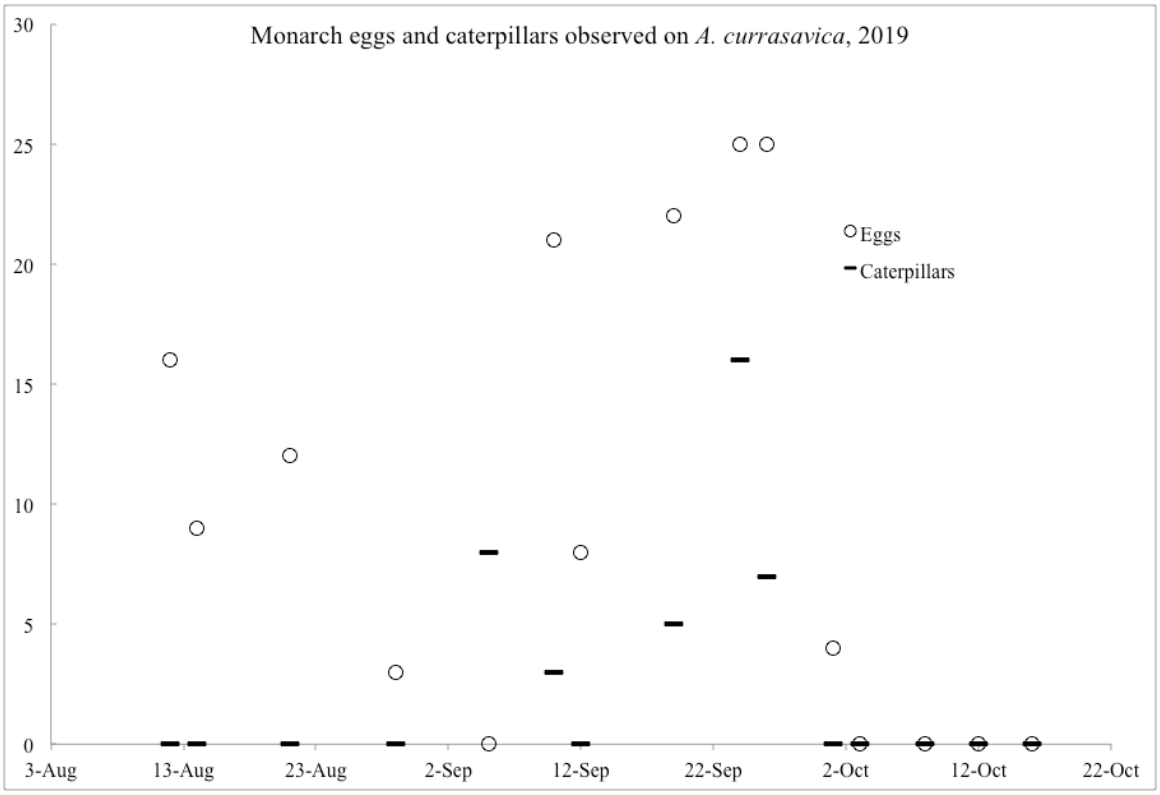

Figure 6 Egg and caterpillar abundance over the course of the study.

The results of our study indicate that the availability of *A. curassavica* in the fall could be detrimental to migrating monarchs. Instead of fueling their flight to Mexico, monarchs exposed to *A. curassavica* may break reproductive diapause to lay eggs late in the season and not complete the fall migration. These late-laid eggs may not have sufficient developmental time to reach the adult butterfly stage and continue the migration south to overwintering sites. The presence of *A. curassavica* has been shown to trigger reproductive physiology and behavior in monarchs. Majewska and Altizer (2019) exposed migrating females to *A. curassavica* and found they showed greater egg development when compared to exposure to native milkweeds. While the native *Asclepias* in our research beds did not thrive in the summer, the 19 native plants with foliage during this period only attracted a single female to lay a solo egg on a 5.1 cm tall *A. viridis* plant. The presence of 48 *A. curassavica* plants in our study, however, enticed reproductive females to lay over 100 eggs throughout the late summer and fall. Research by Baum in Oklahoma (Baum and Sharber 2012, Dee and Baum 2019) show that mowing and fire can stimulate new growth in native *Asclepias*, making fresh foliage available and attractive to monarchs during the late summer and early fall. Unfortunately, since the native species did not grow well during our study, the data we collected in 2019 are insufficient to demonstrate that *A. curassavica* is more likely to attract reproductive females than native species. Growth of the native species in the raised research beds during the 2020 growing season indicate that we will be able to make better comparisons during a second year of observation.

Our observations from the fall of 2019 do indicate that none of the eggs laid during

the late summer and early fall reached adulthood. The first eggs were laid at our research site on 12 August, which would have been plenty of time to reach maturity. However, no caterpillars beyond the 3rd instar or chrysalises were found during the entirety of the study. This is not unexpected given that fewer than 10% of monarch eggs will become adults due to basic mortality causes (Zalucki and Kitching 1982, Goehring and Oberhauser 2002). However, the larval host plant might have contributed to greater mortality. Compared to *Asclepias* species native to northern North America, *A. curassavica* has higher levels of cardenolides, a secondary compound that *Asclepias* plants generate to deter herbivory (Rasmann and Agrawal 2011). Instead of being repelled by them, the monarch caterpillar exploits the cardenolides by sequestering the toxin as a predator and parasite defense. The production of cardenolides in *A. curassavica* is increased with increasing temperature with the potential of high enough concentrations to negatively impact caterpillar fitness. Faldyn et al. (2018) found that monarch fitness was lowered when feeding on *A. curassavica* that was exposed to daytime temperatures of 35°C, which stimulated increased concentration of cardenolides. The average high temperature during August 2019 in central Oklahoma was 34.4°C with 15 days exceeding 35°C (Brock et al. 1994, McPherson et al. 2007, Oklahoma Climatological Survey 2020). These temperatures could have activated the increased production of cardenolides in the *A. curassavica* in our research beds, contributing to caterpillar mortality. Future research into the cardenolide concentrations in fall-growing *A. curassavica* could help to elucidate this confounding factor.

In our study, a majority of the eggs were laid less than one month before the first freeze of the year. While adult monarchs have been known to survive freezing temperatures during their fall migration (Troyer et al. 1996), caterpillars are less tolerant of freezing temperatures and development significantly slows at temperatures below 16°C (Rawlins and Lederhouse 1981). *A. curassavica* is relatively tender and cannot tolerate temperatures below freezing (Floridata n.d.). In 2019, the first hard freeze in central Oklahoma occurred on 12 October (Brock et al. 1994, McPherson et al. 2007, Oklahoma Climatological Survey 2020), causing all *A. curassavica* foliage to die and leaving any remaining eggs or caterpillars without a host plant. This was one of the earliest fall freeze dates on record for this area. The average date of the first freeze in central Oklahoma occurs between 28 October and 2 November. Over the past decade, the first freeze date ranged from 12 October to 19 November (Table 1; Brock et al. 1994, McPherson et al. 2007, Oklahoma Climatological Survey 2020). Therefore, in eight years of the last decade, eggs laid as late as 1 October would have had ample time to reach maturity. As first freeze date shifts later in the year due to climate change, we can expect that eggs as late as 15 October might reach maturity. In an average year, most of the eggs laid in our research beds would have reached maturity. It is uncertain, however, how many more eggs would have been laid by adults if we did not have the early cold snap.

Table 1 Date of first freeze in central Oklahoma as recorded by Norman Mesonet weather station (Brock et al. 1994, McPherson et al. 2007, Oklahoma Climatological Survey 2020) *Complete metamorphosis is estimated to be 24 days from egg to adult under ideal temperature conditions (Zalucki 1982). During late summer and early fall, the temperature will drop below this ideal range and cause larval development to slow. Consequently, this date is likely to be significantly earlier.

Year	Date of first freeze	Last date of egg laid that could possibly reach maturity*
2009	18 Nov	26 Oct
2010	5 Nov	12 Oct
2011	3 Nov	10 Oct
2012	27 Oct	3 Oct
2013	12 Nov	18 Oct
2014	1 Nov	8 Oct
2015	13 Nov	19 Oct
2016	19 Nov	27 Oct
2017	27 Oct	3 Oct
2018	9 Nov	15 Oct
2019	12 Oct	17 Sept

As ecologists, we cannot make firm conclusions on ecological phenomena from one year of data, especially a year with weather data well outside the average. The planting of milkweed for monarchs seems to be a straightforward conservation strategy, but our evidence and that from many other researchers supports the use of native *Asclepias* species rather than non-native species for pollinator conservation gardens and landscaping. With the increased demand of native plants to be commercially available to the public, we anticipate the availability of native *Asclepias* will increase and provide a supply to gardeners and conservationists who want to improve their habitat for monarchs. We will continue to observe the use of the native and non-native *Asclepias* in central Oklahoma with the hope that our work can help direct conservation strategies to best protect this iconic migratory invertebrate.

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Authors are encouraged to submit manuscripts to the editor as an email file attachment to the email address below, preferably by August 1 for publication in December.

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